THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL.

VOL. 28. Thursday, September 27, 1923. No. 371.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial, 17s. 6d. per annum.
All Subscriptions are payable in advance.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
BESSEMER HOUSE, 5, DUKE STREET, ADELPHI,
LONDON, W.C.2.

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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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Co-Operative Pattern Stores.

Every day in the foundry world there are generated the germs of ill feeling or a nervousness which precedes ill feeling because of the movement of patterns. Nine times out of ten there is no substantial basis for this anticipatory nervousness, but the situation could be very largely improved by the formation of large central pattern warehouses from which all patterns would emanate and to which all would be returned. By this we do not refer to foundries attached to engineering shops, but rather to the large buyers of castings and the foundries catering for them. Thus the scheme we have envisaged is one which would carry buildings in Birmingham, Manchester and London. The nervousness to which we have referred as preceding ill feeling is often associated with an engineering firm's request that the foundry shall send certain patterns to another foundry—often a competitor. If the patterns have been constructed by the first firm they will examine their documents to ascertain whether the patterns are their property or that of the purchaser. Obviously if no very clear statement exists, a law case can result, which, apart from delaying business, will introduce the vexed question of "custom of the trade," and varying decisions in various localities.

If central pattern stores on a true co-operative basis were formed, it would ensure that all patterns, whether supplied by the purchaser or the foundry would be sent there on completion of the order, unless otherwise ordered, and the foundries would have no misgivings as to the loss of future business. We can imagine that various engineers will retort that the case would be equally well met by having the patterns returned immediately to the engineering works. This implies that each works must delegate this duty to one man, which when spread over a large number of works introduces this very factor which we wish to eliminate. Then the site of the pattern store must be carefully chosen so as to keep railway charges to a minimum. Again, if firms cared to keep the whole of their patterns in the store, the insurance, also being co-operative, would be less for each individual, and would be included in the charge made for storage, which could be based on the number of bins occupied, or in other words the volume per unit time.

Recently, a firm desired to have some castings made in a new alloy purely for experimental purposes. The foundry where the patterns were lying refused point blank to part with them, and the experiment scarcely warranted the manufacture of new ones. Up to now, the test has not been made, and in this way progress is being retarded. Associated with this question is the inspection and repair of patterns. We suggest that a machine shop should be attached to the co-operative pattern stores, and on receipt of a pattern from a foundry a card should be sent to the engineers stating the nature of the damage and the cost to put the pattern into first-class condition. This price would be compared with that quoted by the purchasers' own department or suppliers, and the matter dealt with accordingly. This would ensure that the central pattern stores did not become similar to what is usually associated with a Government department.

We commend this scheme to the close consideration of the various engineering and foundry employers' associations, as such a scheme should be self-supporting and should effect savings in transport, storage and insurance costs, and addition should make for efficiency in foundry practice by promoting the deletion of obsolete patterns and the rapid movement of current ones, besides promoting better feeling between competing foundries.

If such a scheme as we have set out is never established, the reason will, no doubt, be traceable to one of the causes it is designed to eliminate.

Ferro-vanadium in Norway.—The Stavanger Tinfabrik A/S, Stavanger, intends to start producing ferro-vanadium towards the end of the present year. Arrangements have been entered into with a Philadelphia firm, one of whose engineers will be attached to the new works, and supplies of vanadium concentrates have been secured from Colorado. The Stavanger company has obtained the sales rights for Europe.

Selling Pig-iron on Analysis.

By H. J. YOUNG, F.I.C.

A detailed recommendation on the above important subject has been submitted by the Cast Iron Division of the American Society for Testing Materials, for discussion before the ironmasters of this country and of the Continent in general.

It is not now the writer's purpose to discuss the items of the American recommendation or to say whether he agrees or disagrees with the allowances or tolerances suggested by them.* Such points are secondary in importance to the main issue which is, whether we, as a nation, can see our way clear to selling pig-iron *to any detailed specification whatsoever*.

Everyone entering into this controversy must keep before him the fact that a person does not make or sell pig-iron for the benefit of his health but for that of his pocket. It is therefore a matter of business and not a highly academic discussion.

The first point, a very obvious one, is that one nation or one man may produce iron from such ores as are of a standard quality with the result that pig-iron to a standard specification can be supplied more easily than by another nation or another man who, by reason of locality or other unalterable condition, is forced to use ores which are unreliable and which may alter from time to time or continually.

Every consideration must be given to the above point both by the Americans and ourselves. Everybody must have a willingness and an intelligence to recognise that what applies to one and enables that one to make a profit, may not, to the same extent and in the same manner, apply to another.

The writer has previously published records† showing the hopeless manner in which pig-iron is sold in this country, which records prove that the delivered article is nothing similar to the advertised article. The silicon-content, for instance, may vary by as much as 2 or even 3 per cent., and of the ordinary pig-irons which came under review a variation of 1 per cent. silicon would represent the least variable iron. In that Paper, the writer made the remark that "*pig-iron of standard ultimate composition would solve nearly all the difficulties of the jobbing foundry and most of those of the foundries doing more important castings—which remark applies equally to all branches of engineering and to all types of castings.*"

In reply to a contributor who stated that the silicon can vary in one cast from the blast furnace as much as 0.50 per cent., the writer answered that "*ironfounders are not interested in the 0.50 per cent. variation in silicon, but in the immensely greater and more important variations that can, and do, happen in one consignment, and the still greater ones that happen over a number of consignments over a number of years.*"

The need for pig-iron to be sold to analysis is very real, and the one difficulty is that of proving it possible to carry out as a paying proposition on a large scale. Undoubtedly the time is approaching when it will be done, no matter whether our people want it or not, and the firm or firms which grasp the nettle *now* will obtain the market and get their business organised whilst others are yet wavering or disputing.

The question is solely one of organisation and co-operation between a scientific business man on the one hand and a business-like chemist on the other. Unfortunately, it is true that few reliable analyses of cast iron or pig-iron are issued from the average laboratory, but that is a difficulty easily surmounted. At reasonable cost and with great precision it would be practicable to turn out, every week, hundreds of accurate ultimate analyses of pig-iron, namely, analyses comprising carbon, silicon, phosphorus, sulphur and manganese. Such result would stand the scrutiny of the best referees, and so long as the laboratory was under highly educated and trained management and supervision, there would be no need to worry about it.

The fact that few such analyses would stand scrutiny nowadays is due to things which need not be mentioned here, and it is sufficient to say that mass-analysis of constantly accurate nature is something which anyone can obtain at no unreasonable cost.

It remains, therefore, to organise the pig-iron before and after it is analysed. This would not appear to be an impossible task, and the plant required would seem trivial to a great iron works. At one time it was thought impossible to organise the stock-yard of a large ironfoundry using many different irons *of varying compositions* and making many different classes of castings, and, consequently, of scrap. Nowadays, however, the stock-yard works more smoothly than it did under the old haphazard method—this in spite of the fact that the classes of iron dealt with are more numerous than would be met in an ordinary iron works.

In this country the trouble has been that the phrase "We do not guarantee the compositions advertised" has become a fetish which is often misused and abused. Let only one of our largest iron works break this ring, and sell to analysis with certain stated tolerances, and everybody else will do likewise.

No trade war is necessary or wanted to bring about this reform, and a considered review of the situation together with a little businesslike science is all that is required. Granted that the American proposals may appear unworkable and preposterous to anyone who has adhered to old-fashioned commercial methods and steadfastly ignored the modern requirements of their more progressive customers, but these same methods are beginning to grow prejudicial to the best interests of the trade as a whole, and this position is certain to grow more acute in the near future.

It is to be hoped that our ironmasters will be so advised and so progressive that they will adapt the American scheme to suit their own conditions, by which action it would appear likely that they will serve progress and obtain for British pig-iron the position it deserves to-day as much as ever it did in the past—a position which is being very much shaken by reason of the lack of any desire to sell to analysis at ordinary prices.

* See FOUNDRY TRADE JOURNAL, September 6, 1923, p. 214.

† See FOUNDRY TRADE JOURNAL, December 22, 1921, pp. 497-501, and for December 29, 1921, pp. 511-514.

The Measurement of the Change of Volume in Metals during Solidification.*

By HIKOZO ENDO.

In foundry practice it is very important to know to what extent a change of volume occurs during solidification. The literature concerning this phenomenon is very scanty, because of the lack of a suitable method for arriving at an accurate determination. In 1888 Vincentini and Omodei calculated the change of volume of some metals during solidification from the change of density at the melting point. The measurement of the density of different metals in the vicinity of their melting points has been the subject of inquiry by several investigators. M. Toepler, who studied the change of volume by means of a dilatometer, suggested a relation of the change of volume of a metal at melting point to its atomic weight, similar to that of the atomic volume to the atomic weight. Recently K. Bornemann and F. Sauerwald also measured the density of metals at various high temperatures on the Archimedes' principle, using a mixture of sodium and potassium chlorides as liquid.

The present investigation was started in April, 1921, and the measurement of the change of volume during solidification or melting for a number of metals having low melting points up to 1100 deg. C. has now been finished. This Paper contains the results of the measurements, and forms the first report of the results of the investigation of a long series of experiments, which are to be extended to other metals having higher melting points. The method of investigation consisted in the measurement of the change of buoyancy of a metal suspended in an inactive liquid during its solidification or melting by means of a thermo-balance.

* Paper read before the annual autumn meeting of the Institute of Metals.

National Gas Exhibition.

It is ten years since the last National Gas Exhibition was held in this country, the venue being London. Much has happened since then. Whilst the war lasted the gas-makers gave earnest heed to the nation's cry for materials for high explosives, and concentration in this direction naturally impeded to some extent developments upon commercial lines. Despite every hindrance, however, the ten years that have passed since the last Exhibition have been responsible for greater advance in gas manufacture and its uses than in any similar period since coal gas was first brought into service.

The choice of Birmingham as the scene of a National Gas Exhibition is singularly appropriate. The city's association with William Murdock, one of the founders of the gas industry—for he it was who showed that the gas flame could be made sufficiently luminous to be a commercial asset—was due to the fact that it was in Birmingham that Murdock first introduced the gas lamp, the lamp in this instance being carried in his hand, and the supply of gas for it in a bag under his arm! Apart from all such sentiment, however, Birmingham is an ideal centre for an exhibition of this nature. It is conveniently central for the manufacturers of gas plant and appliances, and is really the hub of industrial England. Indeed, it is not too much to say that Birmingham stands pre-eminent over all other cities or towns for its up-to-date presentment of gas uses. The research work carried on by the City of Birmingham Gas Department may well be described as of national rather than purely local importance

The Exhibition, which was formally opened by the Lord Mayor of Birmingham (Alderman Sir David Davis) on the 17th inst., will remain open until October 3. During the last three days of the Exhibition the British Commercial Gas Association, which has done so much to link together the scattered forces of the gas industry, will hold its annual conference in Birmingham. The Council of the Institution of Gas Engineers will also hold one of their meetings there. We append brief notices of a few of the leading exhibits.

CITY OF BIRMINGHAM GAS DEPARTMENT INDUSTRIAL RESEARCH LABORATORIES.—The main object of interest on this Stand is a new type of high-efficiency gas furnace, having an inside working chamber 4 ft. 6 in. long by 2 ft. 6 in. wide by 18 in. high, working with town's gas at the ordinary Birmingham main pressure with a natural draft. It has been developed by Messrs. Gibbons Brothers, Limited, Dudley, in conjunction with the Industrial Research Laboratories, with the object of producing a heating plant of a high thermal efficiency, especially in the larger sizes having hearth areas of from 3 ft. by 2 ft. up to 12 ft. by 5 ft. The construction follows closely the lines of existing large-type producer gas-fired furnaces, and includes a special type of counter-current regenerator applying to both gas and air supplies. The gas is admitted in bulk through specially-designed ports, and meets its total supply of heated air in a combustion chamber under the furnace hearth. The burning gases pass into the furnace chamber, and thence through suitably arranged outlet ports to the waste-gas flues of the regenerator. These flues are independently controlled by dampers, which provide a simple and effective means of regulating the end-to-end temperature of the furnace. Temperature control is ensured by wheel valves to each gas port, and atmosphere control by separate air slides at the top of the regenerator, communicating direct with each gas port. By these means it is a simple matter to obtain either an oxidising or reducing atmosphere in the furnace chamber. Recent tests carried out on a furnace 4 ft. 8 in. by 2 ft. 6 in. by 18 in. show a thermal efficiency of 35 per cent. under normal working conditions when dealing with charges of 10 cwt. The furnace is shown under temperature and under actual working conditions with charging machine, as arrangements have been made for actual casehardening and re-heating operations to be carried out by the Heat-Treatment Section of the Laboratories. A small-size gas-heated tube furnace is also shown at work on this Stand. It is in use for the special treatment of steel components without oxidation, the work being suspended in a tube, heated externally, through which a sealing gas is passing, burning at the top; thus all air is excluded. Several types of work are available for demonstration.

CITY OF BIRMINGHAM GAS DEPARTMENT exhibit a range of eight miniature rooms, distempered with various colours, each of which is lighted by an incandescent burner of exactly the same candle-power, the object being to show the important effect that the colours have upon the apparent intensity of illumination. Further exhibits include small coke as the ideal household fuel, gas coke for manufacturing purposes, heating apparatus, hot-water supply, breeze for smiths' hearths, washed breeze for high-class forging and welding, also furnace coke for brass-casters and blast furnaces.

H. W. BAINBRIDGE & COMPANY, LIMITED, Birmingham.—Hot brass and bronze stampings for gas and water fittings, also for telephone, electrical, motor, and general engineering trades.

HENRY BEAKBANE, The Tannery, Stourport.—A range of leather and mechanical-leather goods of particular interest to the gas industry.

BRITISH FURNACES, LIMITED, Chesterfield, show a tool-hardening furnace (surface combustion), a rivet heater, a cone fusion furnace, a model of water-gas plant, gas burners, and gas and air proportioners; also surface-combustion furnaces, demonstrating the advance made in the surface-combustion one-valve control system of furnace equipment.

BRITISH URALITE AND CELLACTITE WORKS (THE NON-CORROSIBLE PIPE COMPANY), Higham, Kent.—Exhibit of "Urastone" (Uralite-Asbestone) non-corrosible flue pipes and fittings for gas-heated appliances. The application of "Urastone" flue pipes, etc., is demonstrated by a display of gas apparatus fitted with them. Combined down-draft-preventers and flue-exhausters are made a special feature. Specimen lengths of pipe in "Cellactite," a material which in the near future will be on the market for gas mains, are also shown. This material is claimed to be of great strength and is one-quarter the weight of iron. It is said to be unaffected by the many agents of corrosion which attack iron pipes, both internally and externally, and also by the light oils in vapour present in the gas, such as benzol.

THE BRYAN DONKIN COMPANY, LIMITED, Chesterfield, exhibit models of gas exhausters, lubricators, gas governors; also various photographs.

THE CHEMICAL ENGINEERING AND WILTON'S PATENT FURNACE COMPANY, LIMITED, London, show an open saturator for making one ton of sulphate per day. The special features are: (1) The manhole for inspection and repairs, which can be opened without disturbing any of the pipe connections; (2) an acid spray catch box bolted on; and (3) detachable ammonia pipe and acid pipe, so that replacements can be made without lead burners. A draining table for draining sulphate fished from saturators is also shown, the novel feature being the draining tiles which assist the draining pipe and natural suction, which have replaced the old boards formerly used. Other exhibits include a small ammonia still section, and a model large ammonia still, showing how the contact between the ammonia and steam has been improved, and the flow of liquor prevents any lime deposit settling; a Wilton's patent discharger for sulphate of ammonia saturators; a Monitor case, a new wooden type, which is lighter and easier to handle, and is in two pieces for dismantling the centrifugal basket; a copper centrifugal basket, with the shape altered to give extra strength and capacity without increasing the size; a Wilton's automatic ramless lime pump, which delivers a constant feed of boiling milk of lime to the still; a spent liquor valve; a pressure box.

which acts as a safety valve on the ammonia still, indicates the working pressure, and, in the event of blockage, releases the excessive pressure automatically, and relieves the vacuum on closing down; a neutral sulphate of ammonia drier, consisting of a circular body and revolving horizontal shaft, with lifters which shower the sulphate over steam-heated pipes, thereby converting the salt to a sand-like substance, which is discharged in batches through a suitable gauze, thus avoiding lumps; an automatic weighing machine through which the sulphate passes and is weighed automatically in the bags; a model tar plant for dehydrating tar; the Wilton's patent forced-draft furnace for burning breeze and other low-grade fuels for steam-raising purposes.

CONSETT IRON COMPANY, LIMITED, Consett, Durham.—This exhibit consists of refractories manufactured at Templetown Brick Works for gas-works and coke-oven practice. There are on view samples of the raw material, the finished product in the shape of several feet of 24-in. by 18-in. 95 per cent. silica segmental retort, the jointing of which furnishes graphic evidence of the perfect shape of the bricks.

FOSTER INSTRUMENT COMPANY, Letchworth, Herts., show pyrometers for all industrial and research measurements.

GIBBONS BROTHERS, LIMITED, Dibdale Works, Dudley, have an exhibit comprising a model retort charging machine, a model retort setting, models of Meade's patent producer grate and reflux valve, a hot-coke conveyor chain, an elevator chain, gas valves, producer doors, and retort mouthpieces.

GIBBONS (DUDLEY), LIMITED, Dudley, are showing a machine-made retort, a silicious retort, a silica segmental retort, silica bricks and tiles, firebricks and tiles, regenerator tubes and tiles, etc.

W. C. HOLMES & COMPANY, LIMITED, Huddersfield, exhibit various models of gas plant, etc.

GEORGE KENT, LIMITED, London, show meters for station and district purposes including their station-type meter recorder for registering the flow of practically any quantity, and used in conjunction with either a Venturi tube, orivent or orifice fitting, examples of the latter being exhibited. Kent's shunt meter of the rotary type for measuring the velocity of the gas irrespective of density is also shown, while other exhibits comprise expanding Pitot tubes, boiler load indicator, steam-flow recorder, and curved tube manometer.

MOSBERLEY & PERRY, LIMITED, Stourbridge, exhibit lumps of fireclay (part green and part burnt) showing slight shrinkage; burnt or calcined lumps of old fireclay as raised from mines; model gas retorts; firebricks; boiler-seating blocks and flue covers, etc.

NATIONAL GAS ENGINE COMPANY, LIMITED, Ashton-under-Lyne, show (1) a "V.E." size National gas engine, special electric-lighting type, 50 b.h.p. max. at 230 r.p.m. with town's gas of 420 B.T.U. per cub. ft., coupled direct by means of a flexible coupling to a 30-kw. 220-volt D.C. dynamo; (2) an "L.V.E." type vertical National gas engine, 7 b.h.p. with town's gas at 600 r.p.m., coupled direct to E.C.C. dynamo with combination bedplate; (3) a "K.E." size National gas engine, 6 b.h.p. with town's gas at 430 r.p.m., coupled to 3-kw. dynamo by means of a totally-enclosed silent inverted-tooth chain running on machine-cut chain wheels.

G. B. PARKES, LIMITED, Halesowen.—Malleable iron "P" brand tube fittings for gas, steam, and water purposes are shown on this Stand.

E. PASS AND COMPANY, Denton, Lancs., are showing various improved designs of combined drills and taps for drilling and tapping mains; an improved method of drilling and tapping steel mains and inserting expansion nipples; screwing machines for wrought-iron tubes; ratchet screwing stocks and dies for wrought-iron brass and copper tubes; improved pipe-cutters for wrought-iron tubes, etc.

SHELL-MEX, LIMITED, London.—This exhibit consists chiefly of Mexsol and gas oil. Mexsol is a straight-run petroleum distillate with a low final boiling point, which is now being used by many gas undertakings as a solvent for naphthalene.

SOUTH STAFFORDSHIRE MOND-GAS (POWER AND HEATING) COMPANY, Dudley Port, Tipton, show bituminous paints, varnishes and japans for constructional work requiring a protective or decorative black coating; Zulite wood preservative and stain, a specific against dry rot, insect attacks, etc.; non-poisonous and non-corrosive disinfectants, etc.

STEWARTS & LLOYDS, LIMITED, Birmingham, have a comprehensive exhibit of wrought-iron and steel tubes for the conveyance of gas, water, steam, compressed air, etc., either by the lapwelded, butt-welded, or solid-drawn processes according to size and quality.

THOMAS & BISHOP, LIMITED, London show their "Permac" jointing material, its efficiency and cheap initial cost being demonstrated by a series of joints, which include flanges, screwed-piping, traps, etc. Photographs are shown of its use in coke-oven plants and gasworks.

GEORGE WALLER & SON, LIMITED, Stroud, Glos., have a model of their patent 4-blade rotary exhauster, and also a ½-b.h.p. and a 1-b.h.p. "Phœnix" gas engine.

Proposed C.I. Specifications.

The following correspondence has passed between Sir Robert A. Hadfield and Mr. J. Shaw, the President of the Sheffield Branch of the Institute of British Foundrymen:—

DEAR MR. PRESIDENT,—With reference to the tentative specification for grey iron castings, my firm has given this memorandum full consideration, and we are quite in agreement with the points put forward, specially as regards the use of round bars. We also agree to the variation of the size of the bar according to the size of the casting. No one wishes to multiply the number of test bar patterns, but the old idea of having one size of bar to represent all sizes of castings was certainly most unsatisfactory.

As regards the actual test figures specified, these seem all quite reasonable, neither too easy nor too stringent.—Yours, etc.

R. A. HADFIELD.

Hecla Works, Sheffield.
September 10, 1923.

Personal.

MR. JAMES NEILL, the present senior warden of the Cutlers' Company of Hallamshire, who will assume the mastership of that ancient body on October 9, has had a career of much interest. The son of the late Alderman George Neill, who was five times Mayor of Rotherham, he was born at Sheffield in 1858, and was educated at Wesley College. He has been a steel manufacturer for 35 years, but he started life as an accountant, in which profession he spent several years. The company which he founded, and of which he is now chairman, is that of James Neill & Company (Sheffield), Limited, Napier Street. Their works are called the Composite Steel Works, and their name is a descriptive one, relating to a branch of steel manufacture with which Mr. Neill has been specially concerned. From the first, Mr. Neill adopted as one of his specialities a steel which is largely used in the making of machine knives, press tools, and for many other purposes. He introduced and patented several improvements in connection with the manufacture of this material, but the patents have now expired. It was in Bailey Street that he started business, leasing some crucible furnaces. The business has grown, and has enjoyed great prosperity. It was removed from Bailey Street to Napier Street in 1908. The other directors of the firm are Mr. Robert A. Neill and Lieutenant-Colonel F. A. Neill, D.S.O., the latter being Mr. James Neill's son. The new master cutler is a member of the council of the Federation of British Industries, and a director of the Tinsley Rolling Mills Company, Limited.

MR. VINCENT C. FAULKNER, metallurgical engineer, has changed his address from 21, Stanley Gardens, London, W.11, to Thalassa, Carlton Avenue, Kenton, Middlesex.

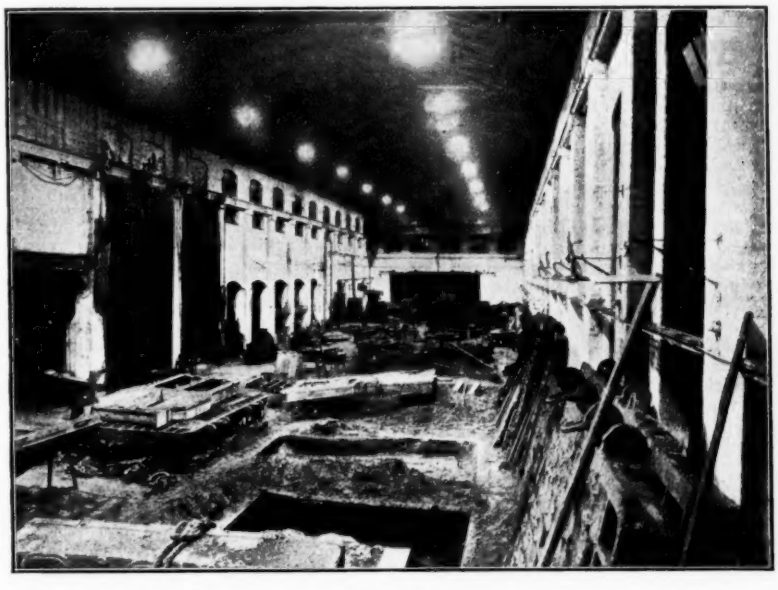
Foundry Lighting.

By W. E. Bush (B.T.H. Company, Limited, Lighting Service Department).

One would imagine that such an important industry as the foundry would make a complete study of conditions which would tend to increase production, and that the management of any foundry would be for ever on the alert to detect and rectify conditions which, if developed, may result in decreased output.

As far as the actual moulding equipment is concerned, recent years have seen vast improvements over that which existed years ago. In the modern foundry it is no longer necessary for a boy to shake sand through a riddle, or for the moulder to ram the sand into his boxes. These operations are now performed through the agency of compressed air or hydraulic power. These and many other improvements are desirable, since they promote efficiency and increase production. They are, therefore, very welcome from the management point of view.

It is possible, however, to increase the production in a foundry without going into details concerning the design of any particular piece of apparatus connected with the work in an endeavour to improve it, yet the means of doing this appear to have been neglected — through the medium of more intense artificial illumination. It is to be regretted that the number of foundries throughout the country where an efficient electric lighting system is installed is very small indeed. Yet good artificial lighting is the best assistant that any foundry manager can give to the moulder.



THE ARTIFICIAL ILLUMINATION OF MESSRS. BELLISS & MORCOM'S FOUNDRY AT BIRMINGHAM.

It would be very hard indeed to conceive conditions in any industry where good illumination is more essential than in the foundry. The nature of the work performed has a decided tendency to keep daylight outside the foundry walls. Casting of various metals is carried out almost every day, and sometimes at night. The smoke rising from the hot sand, the sulphur fumes from the stoves, and the sand floating about in the atmosphere cover the windows with a thick scale of grime, so that the daylight cannot pierce its way through them, and the foundry, therefore, even in broad daylight often presents a very dull and gloomy appearance.

The effect of good lighting upon production is that the moulder can do his work in a much better manner. The interior of a mould should not, as is generally the case, be a mass of dense shadows, thus making it very difficult for the moulder accurately to locate the cores in their position. The illumination should be such that he can see the position into which they are to be inserted without risk of injury to any portion of the mould which, as a result, would be the production of a "waster." Again, when the foundry floor is ready for casting it is completely occupied with boxes, having a very small space between them to allow passage from one end of the foundry to the other. If a bad system of illumination exists, it is a very frequent occurrence for the moulders, when casting, to knock their shins against the handles of the boxes or even to tread on one corner of a box, and so run the risk of damaging themselves or a mould for which money has already been paid.

Core-Making.

It does not matter whether a core is merely a small one made in a box, or whether it is to be built up with loam upon plaited straw, it is necessary that it should be accurately made. It is therefore essential, especially where cores are made to a gauge, that the core-maker should have adequate illumination to enable him to carry out his work in an efficient manner. If a core is badly made it may distort when placed in the oven, and so make a "waster" of the casting if used.

There cannot be too much attention given to the illumination of the foundry when the operation of casting is carried out. One often sees in badly-illuminated foundries extreme difficulty in locating the point on the mould where the metal is to be poured. It is often the case that the moulder, in attempting to pour the metal into the mould, causes a splash of metal, which sometimes has serious results from the fact that it is liable to run into his shoes and so severely burn him. It is not the fault of the moulder—it is due to bad illumination. It is only natural that a moulder, after looking at the intense brilliancy of the molten metal and then glancing at the top of the mould, situated in semi-darkness, that his eyes cannot immediately adjust themselves to the great variation in the intensity of light. Hence the accident.

The same conditions exist outside the foundry at the platform where the scrap and pig-iron is thrown into the mouth of the cupola. Here, if good illumination does not exist, the workmen throwing the material into the cupola run a risk

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of accident because of the great variation in the intensity of light at the mouth of the cupola and the scrap-heap.

Fettling Shop.

Another section of the work in the foundry which calls for adequate illumination is the trimming of castings. The trimmer must, of necessity, use extreme caution when trimming a casting. He must know exactly with what strength of blow the fins can be removed from a casting; a blow delivered too hard may break the casting and so cause not only a waste of time, but probably a considerable amount of expense. If a trimmer cannot clearly see a casting, his blows are bound to be delivered without any sense of judgment; in fact, it would be questionable whether the drift, chisel, or his own hand would receive the blow.

The Foundry Yard.

In the foundry yard, where boxes of many shapes and sizes are stacked, it is essential that good illumination should be maintained. Although every effort may be made to stack boxes securely, it is sometimes necessary, especially during the winter months when darkness sets in, to remove a box from a stack. It is the experience of the writer that many accidents have occurred in an attempt to remove boxes from stacks in badly-illuminated places. Flood-lighting is the correct system of lighting to be used in the foundry yard. It makes possible easy passage in and out of the stacks, without risk of accidents. If a workman is on the top of a stack, slinging a box so that it may be removed from the top with the aid of a crane, he can clearly see to do his work, so that the risk of the box falling from the sling is entirely eliminated.

The illustration shows the interior of a foundry installed with an efficient system of electric light. Such a system is something more than an installation composed of conical shades and bare lamps; it is the result of the experience gained by illuminating engineers whose policy is to design equipment which will meet certain definite requirements. The system illustrated includes the installation of the R.L.M. reflectors, together with the bowl enamelled lamp. This combination makes a unit which not only diffuses the light, but directs it to the point where it is required. With such illumination accidents are practically impossible. The moulder can also see to carry out his work with ease and accuracy. The total absence of glare and the soft shadows are worth serious consideration. Adequate electric lighting is an insurance against accidents. It also promotes efficiency from the fact that the work is performed in a much better manner. It also increases production because the number of "wasters" discovered when castings are removed from the sand is considerably reduced. It should be the policy of the management of any foundry to insist that the moulders have an abundant supply of light. It should be their duty to remove that gloomy and depressing feeling often associated with the foundry. Cheerful surroundings make cheerful workers, and the best means of obtaining cheerful surroundings in industries is through the medium of more light.

JAMES MILNE & SON, LIMITED, of Abbey Hill, Edinburgh, have transferred their branch business at 75, Bath Street, Glasgow, to Mr. G. A. Mitchell, who for many years has been in charge of the branch. The business will be carried on by Mr. Mitchell as Milne & Mitchell.

MR. A. E. HILL, having given up the Glasgow agency for William Hunt & Sons (The Brades), Limited, Birmingham, Mr. J. J. Macadam, of Moness, Burncleuch Avenue, Cambuslang, Glasgow, has been appointed in his stead.

ASHMORE, BENSON, PEASE & COMPANY, LIMITED, of Stockton, have secured a contract, in the face of keen American competition, for a tank and gas-holder for the Montreal Light, Heat & Gas Company, to be erected at a cost of over £100,000.

LICENCES HAVE BEEN granted under the Non-Ferrous Metal Industry Act, 1918, to Eric McAnsh & Company, Sales Wharf, Globe Lane, Woolwich, London, S.E.18; and Mr. C. O. Pattison, "Craignish," 24, Oxnam Crescent, Newcastle-upon-Tyne.

Non-Ferrous Metals in Engineering.*

The autumn lecture at the meeting was delivered by SIR HENRY FOWLER (deputy chief mechanical engineer for the Midland Division of the L.M. & S. Railway), who took for his subject "The Use of Non-Ferrous Metals in Engineering." Speaking of copper, he referred to its use in the construction of locomotive fire-boxes and stays and tubes, and remarked the wear due to erosion and oxidation had undoubtedly been diminished by adding from 0.35 to 0.5 per cent. of arsenic. How much certain defects were due to the presence of oxygen could not at present be fully stated; but if the oxygen in a copper containing 0.35 to 0.5 per cent. of arsenic exceeded 0.15 per cent., it was liable to give trouble in the bending so essential to manufacture. Herein, however, important investigations were being made on behalf of the Non-Ferrous Research Association, which were likely to be of great assistance to engineers. Many alloys had been tried for fireboxes without displacing arsenical copper. One difficulty was that if an alloy was used harder than the copper, it tended to force the copper plate out instead of forming a proper rivet head. Every care should be taken in engineering shops not to raise the temperature of copper too high in working—in any case not above 800-850 deg. C.

The use of copper as a material was small compared with its use as an alloy. These alloys had a great range of tenacity, from over 20 tons to below one ton, whilst their ductility was almost inexhaustible. Bronzes were also of great utility. In the construction of slide valves, investigations made at Derby by Mr. Leonard Archbutt showed that an alloy of 85 of copper, 14 of tin, and 1 of lead was useful when heated to 500 deg. C. and then quenched. As regards bearing metals, no general definition could be given, because varying conditions of load, speed, stress, and lubricants had to be considered. The Midland Railway for many years used a mixture of 83 copper, 9 tin, and 8 lead with every satisfaction for locomotive axle bearings, where the pressure and speed were not great.

Empire Mining and Metallurgical Congress.

The following institutions are co-operating as convenors of the Congress which is to be held at the British Empire Exhibition in London during the first week in June next year: (1) The Institution of Mining and Metallurgy; (2) the Institution of Mining Engineers; (3) the Institution of Petroleum Technologists; (4) the Iron and Steel Institute; and (5) the Institute of Metals; these five representing the scientific and technical interests of the mineral and metal industries, with (6) the Mining Association of Great Britain, and (7) the National Federation of Iron and Steel Manufacturers, these representing the colliery proprietors and iron and steel manufacturers, respectively, of the British Isles.

This is the first Empire Mining and Metallurgical Congress to be held, and it is anticipated that succeeding sessions will be held in the Dominions under the auspices of an Empire Council of Mining and Metallurgical Engineering Institutions, which it is hoped will be constituted as a result of the inaugural Congress. H.R.H. the Prince of Wales has consented to become Honorary President of the Congress.

Viscount Long of Wraxall (late Secretary of State for the Colonies) has accepted the invitation of the Institution of Mining and Metallurgy to deliver the Sir Julius Wernher Memorial Lecture at the opening session of the Congress, and will take as his subject "Mineral Resources and their Relation to the Prosperity and Development of the Empire." The May Lecture of the Institute of Metals, to be delivered by Dr. F. W. Aston, on "Atoms and Isotopes," will also form part of the programme of the Congress.

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* Paper read before the annual meeting of the Institute of Metals.

American Methods in the Manufacture of Malleable Cast Iron.*

By M. GAILLY.

French manufacturers had long been told that the malleable castings turned out by American foundries were much superior to those made in France. In order to test that assertion the author of the Paper paid a visit to the United States and there obtained data relating to the methods adopted. Very soon after his arrival in America he found that the American product was really much better than that of his own country. American malleable was turned out in sections of all dimensions, the metal was perfectly homogeneous, the treatment was even throughout the thickness, and the metal was as easily machinable as good soft iron. Pieces of 4-in. dia. were cast and proved easily workable, whereas with European malleable a thickness of more than ½ in. was difficult to treat thoroughly. Therein lies the essential difference between the two processes; it might be said that the American method does not decarbonise but simply transforms the combined carbon into graphitic carbon.

In the European method it is necessary to decarbonise the iron; if this is not done the metal, too rich in carbon, will lack strength. The outer surface is completely decarbonised to a depth of about 1-32 in., beyond that there is a zone, of about the same depth, in which the carbon is reduced below 1.7 per cent. after which the extent of decarbonisation decreases towards the centre of the casting. It is, however, recognised to be practically impossible to transform combined carbon into graphitic carbon below this content of 1.7 per cent.; beyond the decarbonised zone lies a zone of pearlite which, so far, has not been suppressed.

When dealing with heavy sections it was necessary to prolong the period of decarbonisation for hundreds of hours in order to reach the heart of the metal; but this could only be done at the expense of considerable oxidation of the surface. American malleable being composed entirely of ferrite and graphite is naturally very malleable, whilst the presence of pearlite in the European product considerably reduces the malleability. There is evidence to show that castings up to say ⅜ in. thick, which can be almost completely decarbonised, will give results comparable to American material of the same section.

Walker's test for malleability was adopted in the experiments to determine this property. A weight of 10 kilogrammes (22 lbs.) with a free fall of 1 metre (3 ft. 3 in.) is dropped on the thin part of a test piece of the following dimensions:—150 mm. (5.9 in.) high, 25 mm. (1 in.) wide, 12 mm. (0.473 in.) thick at the base and 1.5 mm. (0.057 in.) at the upper end. The test piece bends and breaks after a certain number of blows, which gives a very fair indication of the malleable properties of the metal. With cupola metal the test piece sustains an average of four to five blows, only occasionally do test pieces last up to eight blows. With metal from a reverberatory furnace the usual figure is from 15 to 20; some pieces even going up to 30 blows without breaking. This test is very severe, and though it may not be extremely accurate the apparatus has the advantage of being cheap and easy to instal.

The American tensile test demands for acceptance an ultimate of 22 tons per sq. in. and an elongation of 10 per cent. on a length of 2 in. The standard test piece is 16 mm. (0.63 in.) and a parallel portion of 60 mm. (2⅜ in.).

Although cupola metal only gives an elongation of 2 to 3 per cent., experiments have been made which have resulted in a minimum elongation of 10.8 per cent. and a maximum of 16.6 per cent., giving an average of 13 per cent. The tensile strength has varied from 23 to 25 tons per sq. in. Tests were made on test pieces of 13.7 mm. (0.54 in.), which is the French standard size for tensile tests of steel, but, since numerous parts of motor cars and agricultural machines have a thickness up to nearly one inch, it is thought that the American standard size of test piece will be adopted in France. If with a test piece of 16 mm. an elongation of more than 10 per cent. is obtained, it may be safely assumed that the malleabilising treatment has been thorough, no matter what thickness the metal may be.

* Translated from a Paper presented to the Paris Foundry Congress.

Drilling Tests.

Machining tests in the United States give the following factors:—Depth of cut, 3-16 in.; feed per revolution, 3-16 in. to ⅜ in.; cutting speed, 132 ft. per minute. For the drilling test a drill ⅝ in. diameter is run at 650 r.p.m., with a feed of 2 in. per min.; the resulting drillings are similar to those from steel. This metal, however, requires more careful attention than the European malleable; if, for example, any defects have to be welded, it is necessary to re-anneal the whole casting, otherwise a hard spot results which might break the tool when the casting is being machined. The moulds must be carefully guarded against dirt, or scabs will be found on the surface of the casting.

Having examined the quality and properties of the American product, the author turned his attention to the methods of working. Reverberatory furnaces accounted for 90 per cent. of the output; the Triplex process is employed in two very large works, and the Siemens open-hearth furnace in two or three factories. The cupola, on the other hand, is gradually disappearing, and is only employed for certain special products such as pipe unions of small size. Cupola metal is not permitted for the manufacture of motor car or agricultural machine parts. The carbon content of metal from the cupola being high—about 3 per cent.—does not give a sufficiently tough iron; in thick sections it is impossible to avoid the precipitation of primary carbon; the iron being in contact with the fuel is bound to take up impurities, and finally it is almost impossible to maintain metal of consistent composition throughout each melt. The Siemens open-hearth furnace appears especially attractive at first because the heat efficiency is so much better than is the case with the reverberatory furnace; it must, however, be run continuously, and consequently demands a very large output; for this reason its use is impracticable in France, at any rate for the present. The Triplex process has similar disadvantages. When using the electric furnace alone it can only be employed in regions where water power is available. Even then it is doubtful whether it is economical because of the large consumption of electrodes and refractories, all of which augment the melting costs. The method of melting in the cupola, followed by partial refining in a converter, is not used in the United States because the operation of the converter is too rapid to allow effective control; moreover, it is almost impossible to obtain consistent results from consecutive heats. All things considered, it appears that the reverberatory furnace is the most suitable for use in France; indeed, two American foundries established in France are using this method.

The heat efficiency of this process is very low, since only about one-tenth of the heat units supplied are used. The wear and tear of refractories is also considerable, with the result that the operating costs are considerably higher than they are with the cupola. In order to obtain a reasonable production cost it is necessary to make two heats per day, that is, a daily output of at last 20 tons. American practice has abandoned the 5-ton furnace, the current capacity being 10 to 15 tons. The great advantage of this furnace is that a metal of uniform composition can be consistently produced, and, as is the case with the electric furnace, any additions to the metal can be made before casting. In order that a regular composition may be maintained a laboratory adjoining the furnace room is necessary, so that tests may be made at regular intervals, thus allowing a constant control of all factors.

The analysis of the iron before malleabilising varied in different works between the following limits:—Carbon, 2.10 to 2.50; silicon, 0.70 to 0.95; manganese, 0.25 to 0.30; sulphur, 0.07 to 0.10; and phosphorus, 0.15 to 0.20 per cent.

These were the limits over a large number of foundries, but there were other works in which the analyses fell outside these figures; occasionally, for instance, the silicon content ranged from 0.60

to 0.65 per cent., and manganese from 0.20 to 0.25 per cent. The average losses during melting have been determined by Mr. Schwartz, Director of the National Research Laboratory, and were published in his work on American malleable:—Carbon, 0.62; silicon, 0.33; manganese, 0.26; phosphorus, 0.00; and iron, 1.14 per cent., whilst for sulphur there is a gain of 0.01 per cent.

It is obvious from these figures that the metal employed must have a very high carbon content, say, 4 to 4.1 per cent. This is the usual carbon content in the United States, but is difficult to obtain in France. It is, however, easily obtainable in England and especially so in Sweden. The English and Swedish irons have the further advantage of being very low in sulphur. That the structure of the material has an undoubted influence on the malleabilising process is well known to foundrymen, but research in this direction is of too recent date to justify any dogmatic statements.

Furnace Heating Methods.

The heating of the furnace may be accomplished in several ways; oil is seldom used in America in spite of its comparative cheapness. Powdered coal is certainly an economical fuel provided that the output be great enough (100 tons of metal cast per day) to justify a pulverising plant. For smaller outputs the individual unit system of pulverising might be employed, but this method does not seem to find wide application in America. The most usual fuel is coal, hand fired; it should have a high volatile content, 35 to 40 per cent.; ash, 5 to 6 per cent., and moisture from 1 to 2 per cent. The bricks generally used are of aluminio-silica with an alumina content of 35 to 40 per cent.; however, any bricks capable of standing up to a temperature of 1,600 deg. C. may be used.

Malleabilising Process.

The American malleabilising process does not require any oxidising material; it is, however, necessary to pack the articles in the muffle in order to avoid deformation: old ore or broken slag is sometimes used for packing. The composition of this packing material varies in different works, but the matter is not of great importance. The temperature at the centre of the box varies from 815 deg. to 900 deg. C.; owing, perhaps, to a higher sulphur content, it has been found advisable at times to increase this temperature to round about 950 deg. C. or as the metal may require. The articles are maintained at this temperature during 60 to 76 hours, though in some works this period is shortened. Up to the present France has reproduced the American methods, but owing to lack of suitable laboratories has done little new research, being far behind the United States in this respect.

The Occurrence of Cavities in Aluminium Bronze.*

By J. Gallibourg and A. Brizon.

Modifications in design of a piece, formerly made as a steel forging, necessitated alterations in the dies which could not be made in time to produce the required part. The decision to replace, temporarily, the steel stamping by a casting in aluminium bronze led to the study of casting conditions for this metal. Some of the results arising from this investigation are embodied in the following notes. So far as the ordinary mechanical properties were concerned, there did not appear to be any serious difficulties: the steel normally used for the purpose had an ultimate tensile strength of 28 to 32 tons per sq. in., with an elongation of 23 per cent.; the aluminium bronze proposed had a composition of copper, 90 per cent.; aluminium, 10 per cent., giving in the cast condition an ultimate tensile strength of 28 to 32 tons per sq. in., with an elongation from 15 to 20 per cent. Unfortunately, aluminium bronze is difficult to cast; if it is treated as an ordinary bronze, cast in sand, three main troubles are almost certain to be encountered. (1) At temperatures above 900 deg. C. there is a strong tendency to grain growth, the metal is brittle, and the fracture reveals large crystals, the dimensions of which may be several millimetres. Attention must be paid to this tendency when the metal is kept for any length of time above 900 deg. C. either during forging or in the slow cooling of the metal in sand moulds. Attempts have been made to arrest the grain growth by the addition of iron to the bath, and the addition of manganese has also been tried. The presence of iron or manganese alters the properties of the alloy; the ultimate tensile strength increases at the expense of elongation. Finally, the rate of cooling of the alloy can be accelerated, between the casting temperature and the dangerous temperature of 900 deg. C., by casting in metal moulds or chills. (2) In order to avoid pipes it is necessary to cast the metal as little above the melting point as possible; one result of this low casting temperature is the formation of cold shuts. Unless special precautions are taken the metal will surge and splash against the cold walls of the mould, solidifying in drops which the incoming metal is not hot enough to re-melt, and which then becomes embedded in the metal. These cold shuts can be reduced to a minimum by bottom pouring or any of the usual methods for ensuring quiet and rapid filling of the mould. The greatest difficulty, however, in casting aluminium bronze is due to its exceptional tendency to pipe. An examination of the equilibrium diagram of aluminium bronze will show that in the region between 0 and 22 per cent. of aluminium the temperature range between the beginning and the end of solidification is very small, a matter of 10 deg. at most, in fact. The result of this small range of solidification temperature is that if the latent heat of solidification is insufficient to maintain the mass in a molten condition it rapidly solidifies, the still liquid metal in feeders and risers is shut off, and is unable to fill up the pipes as they form. This happens in cast objects, and if a casting is cut through the progress of the formation of the cavities which run in a string throughout the casting, can be followed. A section through a feeder or riser shows the seriousness of these cavities resulting from contraction: that they are pipes and not blow-holes can be proved by an examination of their walls and their situation in the casting. The presence of these pipes in the castings under consideration presented a serious difficulty, and led to many rejections. In order to carry out the investigation a survey was made of the methods adopted in casting aluminium bronze in several foundries. Some employed a metal mould pre-heated to a high temperature. Castings so cast by a skilled man, however, included a large number of wasters, due to the cause stated above.

One firm which specialised in the casting of aluminium bronze—also called "forging bronze"—cast their ingots directly from the ladle into the ingot mould by inverting both together; in another method the ingot head is kept liquid for a time by having the upper portion of the mould in sand. Methods which prevent the formation of cold shuts and pipes in ingots are not, however, applicable to castings. The impossibility of feeding the pipes during casting was accepted, and an attempt was made to localise the cavities in parts of the casting which could be removed in the subsequent machining of the piece. The idea was to place cooling elements in suitable parts of the mould.

Since the desired casting was rather complicated, experiments were first tried on castings of a simpler form. The use of these localised chills was not new; they had been in use for some time in the chill casting of light aluminium alloys and white metals, but, apparently, they had not been tried for aluminium bronze. This stage of the investigation was facilitated by macrographic examination. As is generally known, an examination of this nature is made by polishing the surface of a small piece cut from the casting and etching the polished face by means of a suitable reagent; in this case the reagent was a solution of ammonium persulphate in boiling water. The result of the etching is to show up the crystalline structure of the sample, from which the modifications resulting from the treatment the metal has undergone can be studied.

* Translated from a Paper presented to the Paris Foundry Congress.

During normal cooling in a sand mould crystallisation proceeds from two faces gradually retreating towards the centre. When solidification is complete a void is left, due to the contraction of the last portion of the metal to solidify. This sequence does not occur if the rate of cooling of one face is accelerated by substituting a thick metal wall for one of the sand walls of the mould. Solidification now starts from the metal wall much sooner than it does from the sand wall, and also progresses much more rapidly. By this means the cavity is pushed away from the chilled face and locates itself on the opposite side. It is not an easy matter, however, even by the use of a chill of considerable mass, to promote crystallisation sufficiently rapidly as to displace the cavity to the outer side before solidification has set in on that side. The rate of cooling might be speeded up by employing as a chill a better conductor than steel; copper, for instance, has not yet been tried. Nevertheless, in a simple casting of, say, half an inch average thickness a steel chill will displace the cavity to the outer face. It is curious to note that if the skin of metal on the outer face is very thin the cavity does not form. It appears that this thin skin is deflected by the atmospheric pressure and crushes against the crystalline mass at the core. Confirmation of this point is afforded by the existence of an appreciable depression in the surface at the point where a cavity would normally be found. The best positions for the chills are indicated by certain considerations, such, for instance, as the neighbourhood of salient angles in the outline of the piece. It is not, however, always advisable to place the chill at the outside surface of the largest face, because during solidification the metal will contract and no longer remain in contact with the cold surface, which cannot then perform its proper function. After various experiments on the position of the chill it was found that, for this particular casting, the best results were obtained when the mass of steel was placed in an interior position. When in this position certain precautions had to be taken when casting.

Pouring Methods,

Bottom pouring is generally unsuitable, because the incoming metal does not heat up the mould in the neighbourhood of the chill until the casting is complete. The chill, too, is overheated in one spot, and its efficiency is consequently much reduced. It is essential that there should be no splashing in the mould; it is obvious that there will be more danger of cold shuts in a mould that is partly of metal than there would be were it wholly of sand. Mould and chill must be so arranged that the metal has little distance to flow; it should especially be delivered in the neighbourhood of the chill with the least possible flow. The means to attain this end vary with each case.

The importance of keeping the casting temperature within narrow limits by means of a pyrometer was established by these experiments. A temperature of 1,270 deg. C. appeared the best.

The method of casting aluminium bronze described above is obviously neither very economical nor is it of universal application. A large output is necessary to justify the separate chills, which may be difficult to make. Moreover, the castings must be of comparatively simple form and of moderate thickness; $\frac{7}{8}$ in. appears to be the maximum limit. For this reason the sides of the pattern should be little thicker than those of the finished article. Such castings as aluminium bronze chills for casting the white metal for motor bearings are readily made by this method. Aluminium bronze is especially suitable for this purpose, since it does not "tin," consequently the white metal castings leave the chills without sticking. The manufacture, on repetition lines, of simple parts also offers possibilities, the chills being placed in position as though they were cores. The presence of a string of cavities in the thickness of the metal does not necessarily cause the rejection of such articles as annealing boxes and other objects which are used in the unmachined condition.

MESSRS. B. WILSON, F. Wilson and J. W. Flower, engineers and ironfounders, the Union Foundry, Spring Gardens, Doncaster, trading under the style of T. Bashforth & Company, have dissolved partnership, so far as regards Mr. J. W. Flower.

Formation of the Malleable Iron Founders' Association.*

M. Marcel Remy writes, regarding the founding of an association of the manufacturers of malleable iron: "For a long time I have had in mind the formation of an association of the manufacturers of malleable iron, with the idea of controlling this manufacture, improving the processes, and classifying the metal by means of clearly defined characteristics; also to make known the properties of the metal and its better application so as to extend the field of employment of the product. What has been lacking hitherto is a man capable of directing and co-ordinating our efforts; now we have pleasure in announcing that the eminent French scientist, M. Portein, has taken up the matter. Accordingly, with him, and several others, we have decided to take advantage of the International Congress of Foundrymen at Paris to form the nucleus of this association. We have drawn up a preliminary programme.

Preliminary Programme.

In the first place the committee will examine the problems relating to decarbonisation. An attempt will be made to determine the conditions necessary to secure good decarbonisation and the composition of the iron that will give the best results. With this end, each factory will provide representative test pieces for bending and tensile tests: the tensile test pieces to be 10 millimetres (0.394 in.) in diameter. The compositions sought will approximate to the following:—

Cupola.—Carbon, 3.20; silicon, 0.60; sulphur, 0.14; manganese, 0.40; and phosphorus, 0.10 per cent.

Crucible.—Carbon, 3.20; silicon, 0.50; sulphur, 0.07 to 0.08; manganese, 0.40; and phosphorus, 0.10 per cent.

About one hundred test pieces will be cast from each heat. With regard to the tensile test pieces it will be necessary to pay attention to the rate of pouring and the arrangement of runners so that all the test pieces may be cast under the same conditions; this point will be examined by M. Remy.

An outline of the malleabilising programme is indicated by the following figures:—48 to 72 hours at full temperature; 950 to 1,000 deg. C.; 50 hours up to 750 deg. C.; 50 hours up to 600 deg. C.; bringing up to temperature, 24 to 40 hours; cooling, 24 hours; total duration, 196 to 200 hours.

M. Pommerenke has undertaken to carry out such laboratory experiments as he can. M. Remy emphasises the necessity of quick tests which will enable the quality of the material to be determined at any moment. For commercial practice it will eventually be necessary to standardise the apparatus and its application for temperature determinations.

Catalogues Received.

Sanitary Wares.—We have received from Messrs. J. H. Sankey & Son, Limited, of Essex Wharf, Canning Town, London, E.16, a catalogue dealing with both cast iron and glazed sanitary ware. It presents much of interest for both foundrymen and engineers.

Electric Lamps.—A brochure is to hand from the General Electric Company, of Magnet House, Kingsway, London, W.C.2, dealing with the exporting of electric lamps. Our overseas readers will find this of distinct interest.

Grinding Wheels.—The United Carborundum & Electric Works Company, of 72, Station Road, New Southgate, London, N.11, have issued a new price list for various types of grinding wheels, together with a set of rails for calculating the list prices. Additional to vitrified and silicate, shellac and rubber wheels are also included.

Dissolved Acetylene.—A very handsome catalogue is to hand from Messrs. Allen Liversidge, Limited, of 106, Victoria Street, London, S.W.1. It is divided into ten sections, some of which are almost entirely of a technical rather than of an advertising character, and will thus make the catalogue useful when comparing the type of plant to install.

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* Translated from a Paper presented to the Paris Foundry Congress.

Paris Convention Items.

International Test-Bar Situation.

During the river excursion to St. Germain a further meeting was held to discuss the nature of the International Arbitration Bar for cast iron. It was decided that each country should put forward its own recommendations, without criticism of other countries' proposals, but with a full explanation of the advantages to be associated with their own. These reports are to be sent to Messrs. Portevin and Ronceray, who have kindly consented to act as a "clearing house."

The International Banquet.

This function was well attended by all the foreign delegates to the number of about 250. It was presided over by the French Minister for Technical Education, who called upon the presidents of the French, British, American, Belgian and Czecho-Slovakian foundry technical organisations to address the assembly. Speaking on behalf of the American Foundrymen's Association, Mr. G. H. Clamer said he hoped that in 1926 to see as large and influential a gathering of foundrymen in the United States. It had been a real pleasure for him and his countrymen to come from the United States to take part in the first international congress of foundrymen.

Mr. O. Stubbs, speaking as President of the Institute of British Foundrymen, thanked the Association Technique de Fonderie for their reception of his British colleagues. He reminded his audience that the idea of international foundry technical meetings originated during the visit which he paid to the States in conjunction with Mr. Tom Firth, of Sheffield, and Mr. F. J. Cook, of Birmingham. He sincerely believed that the more the various nationalities got together, the better they would understand and appreciate one another.

Mons. Ramas, the President of the Association Technique de Fonderie, in his speech, which was translated by Mons. Ronceray, voiced the welcome of his Association to all the foreign presidents and delegates, and expresed his thanks to his vice-presidents, officers, and chairmen of committees for the part they had taken in organising the Congress and Exhibition. Mons. Espana, who is Spanish Vice-President replied on behalf of the hundred or more Spanish delegates who had taken part in the Congress.

An Anglo-American Supper.

The evening of Friday, September 21, being free, Mr. Clamer, the President of the American Foundrymen's Association, together with other members of the American delegation, invited a fair number of the British delegates whom they had met in Great Britain, to an informal theatre and supper party. The object was, according to Mr. Clamer, to return in a small way some of the hospitality extended to the Americans during their visit to England. After the theatre, the company assembled at midnight at the Café de Paris, and Mr. Oliver Stubbs was the guest of the evening. Replying to a toast of the health of guests, Mr. Stubbs said that not merely those present, but the whole of the foundrymen of Great Britain, would appreciate the thought which prompted the Americans to take such an early opportunity of exchanging courtesies with the British. He felt sure that the friendships which had been established during the past three weeks would be lifelong, and he looked forward to the time when many other British foundrymen would be able to go to the States and experience the true American hospitality which he had received over there, and of which the guests had had a sample that evening. Informal speeches were also made by Mrs. Clamer and Messrs. Minich, Campion, Cole Estep, Bell (American), Lambert, Hollinworth and Faulkner (British), and Mr. F. W. Hobbs, a foundry proprietor from Benoni, South Africa.

The Visit to Le Creusot.

It is to be regretted that only eleven delegates took part in the visit to the enormous factories of Messrs. Schneider et Cie at Le Creusot, as they are amongst the most important and interesting work in Europe. On arrival at Le Creusot on Tuesday evening, September 18, the party were met by automobiles, which conveyed them to their hotel. Each guest was presented with a souvenir booklet printed in English, which included a slip setting out in detail the programme which would be followed, even to the number of the limousine which he would occupy during the visit. At 9 a.m. on Wednesday the party were met by Monsieur le Capitaine de Sezille, to whom the members of the party were presented. The forge was first visited, and the visitors were fortunate in seeing the largest gun ever made being quenched out, the door of the reheating furnace being 75 ft. long and the quenching tank 75 ft. deep. The construction of locomotives, water and steam turbines, and the largest types of engineering plant were successively inspected. Two 60-ton basic open-hearth furnaces were seen tapping during the time spent in the steelworks at Le Breuil. Lunch was served at Mons. Schneider's château—La Petite Verrerie, where Mons. H. Prevost presided. In his speech of welcome he stated that no doubt the visitors would notice the number of Chinese and other foreign labourers in the works. This, he said, was due to the fact that there was a dearth of ordinary labour in France, especially in Creusot where the Schneider Technical Schools insured that practically the whole of the natives became skilled workmen. It was an interesting fact that the works turned out one complete locomotive every day. Mr. V. C. Faulkner, replying on behalf of the visitors, said that the visitors were charmed with the magnificent reception that had been accorded to them. Though he had on many occasions been through the Schneider works, he had always found that new features, plant and methods had been introduced in the interim of the last visit. A go-ahead policy was always associated with the Schneider organisation.

The afternoon was spent in inspecting the new brass and iron foundries at the Henri-Paul works, the latter of which is capable of turning out 40,000 tons of castings per annum. The new rolling mill at Le Breuil and the power station were the last departments to be visited. After dinner at the Hôtel Moderne, the visitors returned to Paris by the night express.

In view of certain statements which have lately been made regarding the National Light Castings Association, the Council have considered it necessary to issue a disclaimer of the allegation that it was formed for the purpose of restricting trade. The Association states that the object of its foundation was not to restrain trade, but to increase it, and to save the British light castings industry from bankruptcy, towards which it was inevitably driving in 1911. As regards prices, the Association repeats that it has offered to the Ministry of Health the most complete facilities for the investigation of its costing system, and of the figures upon which its present price list is based. During the period after the war the Government Accountant did take out the cost and the Association supplied goods to the Department of Building Material Supplies at that cost plus 10 per cent. At the present time, adds the report, the members of the Association are only working at half capacity, and some of their goods, especially rainwater goods, are actually being sold at a loss.

The New Metallurgical Laboratories, of the University of Manchester, which were recently opened by Sir George T. Beilby, are housed in a block which, till recently, was used for other purposes. With comparatively little structural alteration it has been transformed into an adequate building for metallurgy. Structural additions have given the Department four small rooms for research purposes, and have provided separate rooms for all the main branches of work. The laboratories include those for chemical analysis, fuel, pyrometry, mechanical testing, heat-treatment, general work, metallography, including photomicrography. In addition there are: A small foundry, a lecture room, two private rooms for staff, and a small machinery room. The equipment includes a 6,000-lb. Avery tensile testing machine, a Stanton alternating stress machine, Brinell scleroscope, and Herbert small-ball Brinell hardness apparatus, wire torsion and bending machines. The foundry contains injector furnaces by Fletcher Russell, assay furnaces by Morgan, and a high-temperature furnace on the surface-combustion principle by the British Furnaces, Limited, designed for high-temperature work in general and specially for the testing of refractory materials. A small wire-drawing machine and rolls are also available in this room.

XUM

The Value of Fluor Spar in Basic Slags.

By A. C. Dalton.

The value of fluor spar in its application to the basic slags for either the electric or open-hearth furnace, depends upon its fluorine content. The true function of spar, as it is generally called, has, until recently, been one of doubtful value. In the basic electric furnaces its readiness in making ultra-basic slags fusible has been very noticeable, and from this fact of its fluidity at furnace temperature it derives its name. Its secondary property is one of the reduction of sulphur.

Chemically, fluor spar is two parts of fluorine combined with one part calcium in the atomic ratio of 40.07 : 38, so that in the liberation of 38 parts of fluorine, 40.07 parts of calcium are added to the slag, which is already very basic. The metallurgist is always trying to reduce the slag to definite proportions, not only in composition but in mass. The influence of mass is particularly important in electric furnace operations, as bulky slags are not only difficult of manipulation, but are also deleterious to furnace walls and roof.

In view, therefore, of slag control, it is not a little surprising that so little attention has been paid to the quality of spar, which would predispose one to believe that its function is but little understood.

Fluor spar, as mined, may be of various grades of purity, depending upon the nature of the vein and the rocks through which it passes. Associated, however, with fluor spar barytes, calcite, and galena are often found, so that in only exceptionally strong veins is the spar likely to be of high and uniform quality. A good commercial spar in large tonnages should give 94/97 per cent. CaF_2, whilst spar above this is specially reserved for individual markets demanding the highest grades of spar.

In Table I. the analyses of spar from various sources in Derbyshire and Durham are given. They are the ordinary commercial analyses, and often taken over a considerable tonnage, and, as would be expected, the gravel spar shows a wide range of composition. The reason why gravel spar varies so in analysis is that much has been obtained from old dumps, particularly so in the past, but this has chiefly been used for export. However, due to the increased demand for this material, together with a better knowledge of its use, most of the orders reaching this country now demand "washed spar." The reason for this can readily be understood, as on a Derbyshire gravel being washed the silica was reduced from 16 per cent. to 4.75 per cent.

The importance of the percentage of impurities in fluor spar is a feature to which the metallurgist should pay more attention, particularly in electric-furnace practice. When the final carbide slag is obtained, the author has frequently noticed that, after adding the spar, ferro-silicon and lime additions are very necessary, because the spar, often being cheap gravel, may only contain 50 to 60 per cent. of CaF_2 and a large percentage of ferric oxide. It is always advisable in electric-furnace practice to use just a little fluor spar on the end of the shovel and scatter it lightly over the bath, but for the open-hearth lump spar is preferable. During the extraction of lead the best lump spar is broken, washed, and the lead separated, the remaining gravel giving a uniform appearance, and could easily be guaranteed, and therefore both for its size and analysis should be in particular demand for electric-furnace work.

Concerning the percentage of silica in fluor spar, the prevailing specifications stipulate a maximum of 5 per cent. SiO_2 for gravel and 2.0 per cent. for lump. As will be shown later, a certain amount of silica is necessary, and if insufficient to supply the needs of the slag, silica will be reduced from the furnace lining. But gravels such as Nos. 4 and 5 (Table I.) should be in great demand for blast furnaces, where, particularly after a run of hot iron, its use would be very beneficial. Unfortunately the use of fluor spar in English blast-furnace practice is yet in its infancy, but where it has been used its beneficial effect was at once noticeable. In further explanation of the analyses in Table I, only good commercial samples are reported. There are many spars which have come under the author's notice which were only suitable for garden paths, but whilst there was the market for them they were obviously justified in selling it.

TABLE I.—*Analysis of Lump and Gravel Fluor Spar.*

	Lump.						Gravel.		
	No. 1	2	3	4	5	6	1	2	3
Calcium Fluoride	94.1	94.5	77.55	87.25	97.9	94.76	79.55	87.25	91.0
Calcium Carbonate	2.15	2.45	17.50	—	0.54	2.05	—	—	0.6
Sulphates	0.45	0.50	0.45	1.0	0.08	0.80	0.55	1.06	—
Silica	1.25	0.45	1.70	1.05	0.60	0.65	4.17	1.05	7.4

Gravel (*continued*).

	4	5	6	7	8	9	10	11	12
Calcium Fluoride	67.0	72.82	77.55	82.2	89.66	74.9	87.05	87.40	93.8
Calcium Carbonate	0.7	—	11.60	—	2.55	8.55	—	9.60	2.8
Sulphates	—	—	—	1.63	—	3.5	—	—	0.2
Silica	29.36	22.0	9.80	5.45	4.55	8.76	4.1	2.70	2.25

No. 2 & 3.—Samples from the same mine, being sold as first and second quality.
„ 10.—Washed Derbyshire Gravel.
„ 11.—Washed American Gravel.
„ 12.—Washed Derbyshire Gravel, from lead crusher.
„ 3.—Mixed lump and gravel only sold as such.

Influence of Fluor Spar on Basic Slag.

In studying the reactions of fluor spar in basic slags, it is soon found that there is yet considerable amount of work necessary, but its functions are twofold: (1) As a desulphuriser, (2) as a liquefier of basic slags.

In electric-furnace slags the addition of fluor spar has considerable influence in lowering the fusibility of the ultra-basic slag, whilst still maintaining its basicity, but the presence of silicon is necessary, therefore Rodenhauser considers that ferro-silicon plays a similar part to fluor spar, and gives the following equations:—

(1) $2\,CaO + 2\,FeS + Si = 2\,CaS + SiO_2 + 2\,Fe$
(2) $2\,CaF_2 + 2\,FeS + Si = 2\,CaS + SiF_4 + 2\,Fe$.

From the above the SiF_4 is presumed to be volatilised, depending upon the lime content for the retention of the sulphur. Harbord also confirms the presence of carbon and silicon as being necessary adjuncts for the reduction of sulphur. Recent research at a German steelworks, the results of which were published in the "Stahl und Eisen," gives an important modified explanation of the use of fluor spar in open-hearth practice. It is there shown that the desulphurisation of the bath is not entirely a reaction of CaS, but that a fluoride of sulphur is formed, which is volatilised, and that an equilibrium of calcium fluoride is

obtained at about 2 per cent. Some of the excess fluorine is evidently evolved as silicon tetra fluoride, as was proved by the precipitation of gelatinous silica in the outgoing gases on passing them through water. This reduction of the silica from the slag is eventually restabilised by additions from the furnace refractories, so that in contradistinction to previous opinion the slag does not become more basic, as is shown by the following figures, taken from a 60-ton furnace:—

Test.	Time.	% of SiO_2 in Slag.
1	10–28	17.23
	10–30	1,764 lbs. of fluor spar added.
2	10–33	17.05
3	10–37	16.18
4	10–43	17.08
5	11–13	17.70

The sulphur was reduced from 0.081 to 0.06 per cent. in the bath, which finished on tapping at 0.042 per cent. at 12.12.

It is also of interest to note the comparison of sulphur in steel and the percentage of calcium fluoride in the slag. The samples were taken ten minutes after the addition of spar, and every following ten minutes until tapping.

S. in steel	0.11	0.076	0.074	0.07	0.063	0.056	0.052%
CaF_2 in slag	6.03	4.10	3.40	2.27	2.09	2.21	2.00 %

Tests taken on seven finishing slags gave approximate results of the reduction of CaF_2 to about 2.0 per cent.

The figures in Table II. are of particular interest, as showing that the reduction of sulphur does not depend upon the lime content solely, as shown by the results of two heats worked under as similar conditions as possible, only one with and the other without spar.

It was also noticed that the sulphur content of the slag did not increase on the addition of spar, but decreased, thus making the slag able to absorb more sulphur, the previous sulphur being volatilised as follows:—

Time.	Sulphur in Steel.	Sulphur in Slag.
10–55	0.081	0.233
11–00	1,764 lbs. of spar added.	—
11–20	0.06	0.165
11–40	N.D.	0.182
12–12	0.042	0.220
12–13	Tapped.	—

The above figures suggest that some volatile silicon tetra fluoride is formed. In low carbon heats it was found that an actual reduction of sulphur from the slag can take place, but is re-absorbed at a later time.

Table III. compares the final analyses of electric furnace basic slags, all of which were approximately white, and all of which evolved acetylene, on quenching.

TABLE III.—*Analyses of Basic Slags.*

Constituents.	No. 1		No. 2		No. 3
	A	B	A	B	
SiO_2	26.3	26.5	23.0	23.60	26.0
Fe_2O_3	0.42	0.25	0.14	0.29	4.71
FeO	3.85	6.08	0.67	0.90	tr.
Al_2O_3	4.40	4.10	3.48	3.22	5.29
MnO	0.34	0.27	1.86	1.30	0.93
CaO	49.73	43.08	60.30	60.30	56.20
CaS	0.47	0.66	1.70	1.61	—
MgO	14.15	17.00	7.39	7.90	6.87

In the above samples Nos. 1 and 2 A was taken ten minutes before tapping, and B just before tapping. The object at the time of taking these samples was that frequently the sulphur in dead soft steels was noticeably higher than in ordinary carbon and alloy steels, and on plotting the sulphur contents of the bath, it was found that though a carbide slag was purposely kept, the sulphur fell very slowly and gradually, but there was a sharp drop between the final bath sample and the finished steel, which must be attributed to the mechanical effect of pouring, bringing about suitable conditions for oxidation and evolution of the sulphur, as will be seen from Fig. I.

There is also another question arising in view of these reported results, to what extent is a carbide slag really economically and metallurgically advisable in the electric furnace? In fact, the whole metallurgy of electric furnace slags suggests further investigation, as too little attention has been paid to the control of the slags. Rather has it been the policy to admit some mysterious influence and property in the operation.

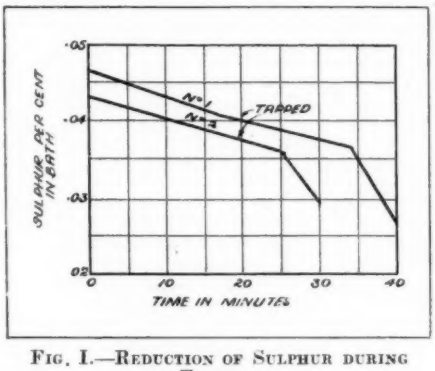

FIG. I.—REDUCTION OF SULPHUR DURING TAPPING.

[Mr. Dalton has chosen some curious analyses as examples. No. 1, for instance, would indicate that something was radically wrong with the hearth of the furnace, since it contains such a heavy percentage of magnesia. In sample No. 3, we suggest that the presence of nearly 5 per cent. of ferric oxide would not be a suitable finishing slag. The conclusion drawn from Fig. I., that the sulphur is reduced during tapping, is contrary to our experience, and requires confirmation before acceptance. It has been noticed that the complete absence of movement in a basic electric furnace makes for low sulphur in the finished steel. As fluorine is exceptionally difficult to determine, owing to the fact that it attacks glass, the method employed could advantageously be stated.—EDITOR.]

TABLE II.—*Sulphuric Reduction using Open Hearth Slags with and without Fluor Spar.*

	SiO_2	Fe_2O_3	FeO	Al_2O_3	MnO	P_2O_5	CaO	MgO	S	CaF_2	S in steel.
Without spar ..	15.20	3.57	8.14	2.14	5.41	4.76	46.5	12.97	0.32	—	0.09
With spar ..	19.63	2.86	11.57	3.36	5.63	2.62	45.98	4.55	0.44	2.26	0.06

METALS & ACCESSORIES, LIMITED, St. David's House, Llanelly, are constructing new sidings, to be used in connection with the depôt for metals and materials for the shipbreaking yard and service departments at the North Dock, Llanelly.

Czecho-Slovak Iron and Steel Industry and the Ruhr Occupation.—The influence of the occupation of the Ruhr on the Czecho-Slovak iron and steel industry is clearly shown by recent official figures. Exports of iron and steel to Germany during 1922 did not exceed an average of 590 wagon loads (of 10 tons) a month. During the first three months of 1923 the monthly average rose to 1,490. In April and May the average was 3,242, and in June 3,510. There was a slight falling-off in July (3,500 wagons). Since the beginning of 1922 exports of iron and steel from Czecho-Slovakia to Germany have more than doubled, while they are now 30 times larger than they were in 1920.

French Bounties for Pig-iron Exports.—These bounties are paid on exports of French pig-iron by the Société des Cokes de Hauts Fourneaux (S.C.O.F.), and not actually by the French Government. Each month the perequation price of coke is established by the S.C.O.F. on the basis of the cost price of the different grades of metallurgical cokes and of their tonnage. An average price per ton is then obtained, but not charged. A certain sum is added in order to cover any possible change that may occur, and also to distribute to the works who are members of the S.C.O.F., a premium or bounty per exported ton. It is, in short, a co-operative reimbursement of part of the price paid for coke. The Government has nothing to do with the payment of the bounties, which are of a private character. At this moment the price of German coke is much higher than the perequation price.

Compressed Gas Firing of Open-Hearth Furnaces.

HERR GERHARD DONNER, in a recent issue of "Stahl und Eisen," describes some tests carried out, and the results obtained, on an experimental 3-ton open-hearth furnace heated by compressed gas. Dealing with the general question of firing, the author states that it does not necessarily follow that gases of high calorific power will exhibit high combustion temperatures; it is entirely a matter of the composition of the gas or mixture of gases used. Methane, for instance, with a calorific power of 8,600 kg.-calories, when used with air heated to 1,100 deg. C., gives a theoretical combustion temperature of 2,390 deg. C.; water gas of 2,580 kg.-calories gives a theoretical combustion temperature of 2,420 deg. C., and so on, while, of course, the quantities of air required for combustion vary with the composition of the gas. The author has found that in many cases these theoretical combustion temperatures are not attained in the furnace, hence the necessity for suitable gases and high air temperature. Further, the existing method of mixing the cold gas with hot air at ordinary pressures is not economical, in view of the high degree of economy obtained with modern burners of the Bunsen type, as used in other industries, particularly gas lighting.

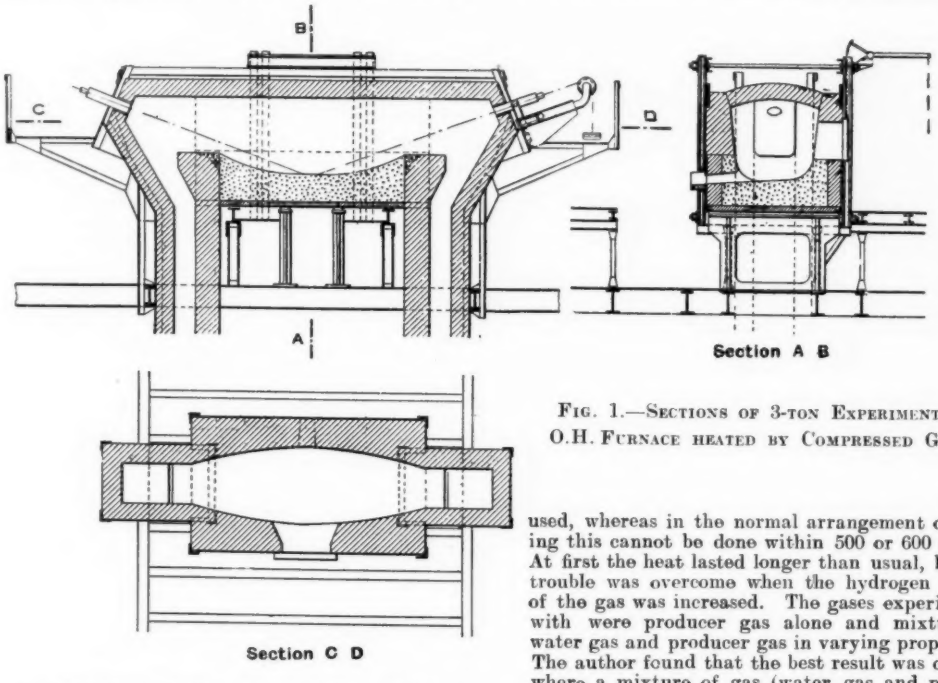

FIG. 1.—SECTIONS OF 3-TON EXPERIMENTAL O.H. FURNACE HEATED BY COMPRESSED GAS.

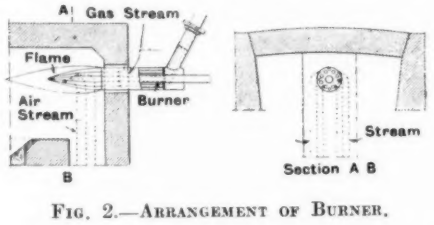

FIG. 2.—ARRANGEMENT OF BURNER.

The problem of obtaining a satisfactory burner to deal with gas and heated air at a pressure of 2,000 mm. (say 79 in.) of water was a difficult one to solve, owing to premature combustion, back firing, etc. The type of burner used and a sketch of the experimental furnace itself are given in Figs. 1 to 3. This particular furnace was converted, for the purpose of the experiments, from an old 3-ton furnace used for melting ferro-manganese and Spiegeleisen. Fig. 2 shows the arrangement for ensuring a proper mixing of the air and gas. As will be seen, the gas current is split up into a number of jets, the hot air being sucked in between the jets by the force of the gas, and thoroughly mixed with the gas. The burner is made of iron sheets welded together, and is water-cooled. The burner can be swung out of the way for purposes of inspection. The flame, it will be found, is made up of an inner cone, much shorter than that in the ordinary Bunsen burner, with ragged ends, and, above this, a much longer pale-blue cone. With a correctly-dimensioned burner the flame is long enough to play on the whole of the furnace chamber. With this arrangement of burner the gas and air ends can be dispensed with, because the gas, being under pressure, automatically follows the direction in which the burner is pivoted.

The experimental heats carried out in this way showed that it was possible to get within 100 deg. C. to the theoretical combustion figures of the gases used, whereas in the normal arrangement of heating this cannot be done within 500 or 600 deg. C. At first the heat lasted longer than usual, but this trouble was overcome when the hydrogen content of the gas was increased. The gases experimented with were producer gas alone and mixtures of water gas and producer gas in varying proportions. The author found that the best result was obtained where a mixture of gas (water gas and producer gas half and half) was used having a theoretical combustion temperature of 2,200 deg. C. The heat took two hours and less as against six or seven hours with gas poor in hydrogen.

It is proposed to continue the experiments with a 20-ton furnace, as there is reason to believe that the results obtained will be equally satisfactory as those obtained with a 3-ton furnace. A considerable saving in gas is expected.

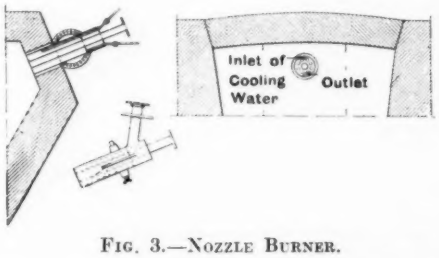

FIG. 3.—NOZZLE BURNER.

In conclusion, the author, referring to German conditions, thinks the gas-producing problem could be solved by coking the coal, and so obtaining coke-oven gas and coke, converting the coke partly into producer gas and into water gas, and combining these three gases into a mixed gas having a theoretical combustion temperature of, say, 2,200 deg. C. The gas would contain no heavy hydrocarbons and very little water vapour, and could easily be freed from dust in the scrubber and then conveyed direct to the compressor. Where there is no coking plant available, water gas and producer gas could be obtained from coke purchased, and these two gases mixed.

XUM

An Apprenticeship Course in Foundry Practice.—LIX.

By Ben Shaw and James Edgar.

Steel and Steel Castings.

There are so many grades of steel that it is difficult to deal with it in such a way that all are considered. It is more commonly referred to as an alloy of iron and carbon. The carbon is present in small quantities only, but usually in greater proportion than it is present in wrought iron and less than in cast iron. In addition to carbon, other elements are always present to a varying extent, not because they are essential, but because it is not possible to remove them entirely from the composition of the steel during the ordinary process of manufacture. These elements are similar to those associated with the composition of cast iron, that is, silicon, sulphur, phosphorus and manganese are present, although, apart from the manganese contents, the percentage of these elements is much less than in cast iron. Steel may, therefore, be classed as a less pure form of iron than wrought iron but purer than cast iron, and, in a sense, it may be referred to as occupying an intermediate position between wrought and cast iron. It is sometimes termed an alloy of iron and carbon that hardens when heated to redness and quenched in water, but this definition excludes what are commonly known as mild steels containing less than 0.5 per cent. of carbon, as these are not sensibly hardened when so treated. Of the elements present in steel, the sulphur and phosphorus contents should be guarded against. It is too costly a process to so reduce the contents of these elements that only traces remain, but it is essential that they be kept as low as practicable. In order to give steel certain characteristics that are desirable for the specific purpose for which it is to be used, other elements, beside carbon, frequently enter into its composition. Thus nickel, tungsten, chromium, vanadium, titanium, molybdenum, and manganese may be the predominating element in the composition of a steel for special purposes. These are known as special or alloy steels, as distinct from carbon steels, and are frequently referred to as nickel steel, chrome steel, etc., according to the name of the special element in the composition. We can, therefore, divide the steels into two main groups—carbon steels and alloy steels.

Carbon Steels.

The term carbon steel refers more particularly to those that contain the elements previously referred to but of which the carbon is the most important. There are many varieties of carbon steel, differing in their degree of strength, malleability and hardness according to the composition, but particularly with regard to the amount of carbon in the composition. These steels are broadly divided into two, three, or four kinds according to different forms, selection and use. Thus they may be referred to as soft and hard steels, as soft mild and hard steels, or the latter with the addition of tool steel. While the physical properties of the steel are sometimes used to denote a particular grade, these qualities are governed largely by the percentage of carbon it contains, consequently, in many cases, instead of referring to a carbon steel as mild or hard steel, it is referred to as a steel having a definite carbon percentage in its composition. The approximate percentage of carbon in dead soft steel may vary from 0.05 to 0.2, in mild steel from 0.2 to 0.4, in medium steel from 0.4 to 0.65, and that in tool steel from 0.65 to 1.5. The terms that are applied to steel, however, vary so much that these percentages are only suggested as a guide. Not infrequently all steels that are made by the Bessemer or by the open-hearth process are referred to as mild steels to distinguish them from the steels made in the crucible or electric furnace, but this method is very misleading, as many steels produced in the electric furnace, in particular, are also mild, having a low carbon content. In a general sense all those steels that have up to 0.5 per cent. of carbon in their composition are considered to be mild steel, while those that exceed this percentage of carbon are hard steels in comparison. It is, however, not possible to make a definite separation of these two kinds of steel, as the one gradually passes into the other according to the carbon contents. If we refer to the mild steels as low carbon steels and hard steels as high-carbon steels, then it is possible to give the general distinctive properties of these two kinds of steels. Thus a high-carbon steel will have a crystalline or granular fracture, the texture depending very much upon the heat treatment to which it is subjected. Such a steel has a high tensile strength, but its ductility is low. It is therefore difficult to work, and this difficulty is increased with the increase in percentage of carbon in the steel. High-carbon steel, however, has the property of hardening when heated and quenched in water. It is this property that makes this class of steel so useful for tools, and for this purpose the work for which the tool is best suited is determined by the percentage of carbon in the steel, the percentage of carbon determining the degree of hardness of which it is capable when treated in the manner referred to and known as tempering. This class of steel is frequently graded according to the particular kind of temper desired and known as set, chisel, spindle, turning tool, saw file, and razor temper steels, the percentage of carbon in these steels rising gradually from 0.85 in the case of set steels. Low-carbon steels have a granular fracture, while their tensile strength will be less, but toughness and ductility is increased. These properties, coupled with the fact that low-carbon steels are more easily worked than high-carbon steels, make them suitable for those parts of mechanism that are subject to shocks, the effect of which would fracture a high-carbon steel. Thus low-carbon steels are used for forgings of different kinds, various kinds of structural work, ship, boiler and tank plates, rails, etc.; in addition low-carbon steels include steel castings, a term applied which is distinct from cast steels, which is applied to a high-carbon steel.

Alloy Steels.

For many years now there has been a necessity for special kinds of steel to cope with the exact demands of modern engineering, and after much invaluable research work special kinds of steel have been produced to meet special needs in which elements, other than carbon, are the predominating factors in determining the physical properties of steel. These are known as alloy steels. In order to produce these steels commercially special alloys are added to the ordinary steel mixture containing a high percentage of the special element, and these are generally referred to as steel alloys. Thus ferro-nickel, ferro-chrome, ferro-manganese, etc., are steel alloys, and are used in the production of nickel, chrome, and manganese steels respectively, and these steels are known as alloy steels to distinguish them from the carbon steels. The addition of nickel to steel in the formation of nickel steel produces a steel of greater ductility and elasticity than a carbon steel of equal strength. The contents of nickel usually vary from 2 to 5 per cent., but may be very much higher. It is used where strength combined with toughness is required, and when its relatively higher cost does not preclude its use. It is particularly useful because of the greater resistance it offers to corrosive influences than carbon steel. A nickel steel having a nickel content of about 3 per cent., with some chromium present, is as strong as a high-carbon steel, but whereas the high-carbon steel would be hard and brittle, the nickel steel would be as tough and ductile as a very mild carbon steel. Steel that has a small percentage of chromium in its composition is hard and tough. Chrome steel is not so readily injured by overheating, and is used for making good-

quality tools and balls for ball-bearings. Heated to a moderate temperature and quenched in water, chrome steel is extremely hard and yet is not brittle like a high-carbon steel. It is used in rock-crushing and stamp-mill machinery for those parts subject to severe shock and heavy wear, and in conjunction with nickel for armour-plate and projectiles.

Very small percentages of manganese in steel do not affect its character much, but when the manganese contents is increased to 2 per cent., the strength and ductility appreciably diminish and the steel is harder and the steel increases in hardness with the rise in percentage of manganese, having a maximum hardness when the contents are about 6 per cent. It is used for wearing parts in connection with grinding and crushing machinery, for the frog crossings, connecting rails, and for work that is subjected to heavy wear. Manganese steel casts well and it can be forged at a moderate heat, the extent to which it can be forged depending upon the manganese content.

Chrome vanadium steel is used in the American motor-car industry, the small percentage of vanadium, varying from 0.2 to 0.9 per cent., increasing the strength and toughness of the steel considerably, so much so that the design can be lightened and yet possess the strength that would be required of a heavier sectioned design in carbon steel. Thus by its use weight can be reduced without weakening the structure or reducing its effectiveness. The presence of tungsten in chrome steel increases the hardness of the steel. It is used in the production of special high-speed tool steel, providing a steel capable of cutting chilled rolls. Chrome tungsten steel is self-hardening and requires a special process of annealing in order that it may be machined to make hoist drills and the like. Considerable skill is required to work it. There are, of course, many other alloy steels having varying uses and containing a special element by which the steel is known, or in some cases some of these elements are combined in one steel, thus tungsten and chromium and vanadium are often associated in the one composition, but sufficient has been said to assist the student in grasping the meaning of the term and potentialities of alloy steel.

Steel Castings.

Although in the wider sense all steels except shear steel may be said to have been castings, since they have been poured in a fluid state, the term steel castings is applied more particularly to those that are given the required form at the time of pouring and comparable with iron castings. In some instances the term is applied to ingots or billets that are cast in steel which are used either for forging, as in the case of shafts, rudder posts, anchors, etc., or for rolling, as in the various structural steels, rails, bars, plates, etc., or for drawing, as in the case of pipes, tubes, wire, etc., but while the student should bear in mind that the composition of the steel is somewhat similar for each class of work in the sense that they come under the category of low-carbon steels; further reference to steel castings will deal more particularly with those that are given the requisite shape when cast and do not need to be worked apart from any machinery that may be desirable.

The use of steel castings has undoubtedly been extended considerably during recent years. Formerly they almost entirely consisted of large castings such as stern frames, and other castings of a similar nature used in connection with ship construction, heavy castings associated with large forge hammers, blast-furnace castings, etc., and many of these were produced and imported from the Continent. Now, however, not only are these castings invariably produced in this country, but the uses of steel castings have materially increased, particularly for work of smaller size. Thus the facilities in this country for producing steel castings of varying sizes have been rapidly extended. Amongst the castings made in steel may be included oil-engine cylinders, high-pressure turbine nozzle casings, high-pressure valves of large size, numerous small castings in the motor-car industry, dynamo frames, hydraulic cylinders, tramcar bogie-frames, numerous castings used in locomotive construction and for rolling stock, and the need for new application of steel castings is continually arising.

The kind of steel castings referred to usually consist of a steel possessing a carbon content up to about 0.5 per cent., but averaging 0.275 per cent. Now, although steels used in the production of castings are low in carbon, and in the wider consideration of steel are referred to as being mild, they are again subdivided by the foundryman into grades. But it must be distinctly understood that this grading of soft, medium, and hard steel concerns only steels having a carbon content up to about 0.5 per cent., and is only applied as a relative comparison between steels suitable for different types of castings. Thus a soft steel may contain up to 0.25 per cent. of carbon, a medium steel 0.35 per cent., whereas a steel having a carbon content of 0.5 per cent. is hard by comparison. The use of the soft steel for castings is undoubtedly due to its greater resistance to shock without fracture. Whereas a hard steel will fracture under exceptional stress, a soft steel is more likely to buckle, and consequently for many types of castings it is more reliable. Usually, however, the softer the steel, that is, the lower the carbon content in the steel, the more difficult it is to produce sound castings. The carbon contents of the steel, besides influencing its mechanical properties, also affects the melting temperature; the lower the percentage of carbon in the composition the higher the melting point.

Difficulties in Producing Steel Castings.

Steel is cast into dry-sand and green-sand moulds in somewhat the same manner as cast iron, but the temperature of molten steel is higher than that of cast iron, consequently the material of which the mould is made, particularly that which forms the face of the mould, must be of greater refractoriness. Thus the face sand for moulds to receive molten steel should be free from impurities that fuse at a lower temperature than the metal. The selection of sand must therefore receive special care, but though every precaution is taken with sand mixture used, some impurities will be present, and consequently the surface of steel castings is rarely as clean and smooth as that of iron castings.

Another difficulty is experienced as a result of the relatively high shrinkage of steel. This is undoubtedly the factor which gives the steel moulder most trouble. The mould must be strong enough to withstand the rush and pressure of the fluid metal, and yet weak enough to enable it to contract. The steel is in its weakest state just after it has solidified, and it is at this stage that the greatest amount of shrinkage takes place. Thus the steel contracts more rapidly just after it has solidified, and unless the mould readily gives to the strain of the casting, the casting itself is likely to be ruptured, or it may hold together for a time but ultimately the internal strains in the casting due to the resistance offered by the mould or by the thinner sections will cause it to fracture. This difficulty increases the cost of the production of moulds to receive steel because of the many precautions which must be taken to cope with contraction. We discussed more particularly these precautions in a previous article of this series, to which the student is advised to refer. All steel castings are strained to a more or less extent, not only because of the resistance to complete contraction offered by the mould, but because of unequal thicknesses of adjacent sections, and in order to release these internal strains the process known as annealing is resorted to. This process consists in heating the casting in a special annealing furnace to a temperature of approximately 950 deg. C., and maintaining it at this temperature for a varying length of time, depending upon the type and design of the casting. Thus, while care is necessary to ensure the gradual rise in temperature to enable all parts of the casting to be equally heated, it is important to preserve the same condition when cooling down to a normal temperature. This process, when properly done, softens and toughens the steel in addition to releasing it from strains.

The four main processes for manufacturing commercial steel are by means of the open-hearth furnace, and the electric furnace, which we purpose dealing with in a separate article.

XUM

The Relation of the Metallurgy of Cast Iron to the Design of Castings.*

By P. A. Russell, B.Sc.

Cast iron is frequently considered by designers to be a somewhat unreliable material. This may be so to a certain extent, for the nature of the material is such that it is bound to be weak compared with other engineering materials such as steel. But cast iron has advantages—firstly, its relative cheapness both in material and ease of casting into intricate shapes. Cast iron is also of great strength in compression, is rigid, easy to machine, partially self-lubricating, and fairly resistant to corrosion. Its unreliability can be reduced by a great deal with a fuller understanding of its metallurgy—that is, the relation of its chemical analysis and its subsequent treatment in the casting process, to its strength and other mechanical properties. The object of this article is to set out as clearly as possible the various aspects of the metallurgy of cast iron that affect the designer. It is proposed to deal solely with grey-iron castings for ordinary engineering purposes. The metallurgical explanations given are necessarily incomplete, and some of the statements may be considered controversial, though as far as possible plain, well-established facts have been given.

Before considering the various factors that control the relative proportions of combined and graphitic carbon, the effect of the other impurities on the strength of the cast iron should first be considered, apart from any other influences they may have. Silicon and manganese both have the slight effect of increasing the strength of the background or matrix. Sulphur, particularly in excess, weakens the iron. Phosphorus has a very weakening effect on the matrix, appearing, in chemical combination, as patches of hard and brittle material. Low phosphorus irons are, however, expensive and rather more difficult to handle in the foundry, as phosphorus aids the fluidity of the molten metal. Thus the maximum amount of phosphorus should be allowed commensurate with strength. For special work, including castings to be used at high temperature, the iron should be of the hematite variety (*i.e.*, phosphorus less than 0.1 per cent.); for strong castings, phosphorus about 0.5 per cent., and for ordinary engineering castings 1 to 1.5 per cent. The weakening effect of phosphorus about 1.5 per cent. becomes so marked that it should not be allowed to exceed this except for very light castings taking no load.

Factors Influencing the Proportion of Graphite to Combined Carbon.

Silicon.—This element is by far the most important one in this respect. The presence of silicon increases the tendency of the iron carbide to split up giving free carbon or graphite. A series of researches was carried out by Professor Turner on this subject, and he showed that, other conditions being equal, the effect of this element on the strength of 1-in. square cast-iron bars is as follows:—

Maximum hardness	Silicon under 0.8	per cent.
do crushing strength	,, about 0.8	,,
do transverse strength	,, ,, 1.4	,,
do tensile strength	,, ,, 1.8	,,
do softness and working qualities	,, ,, 2.5	,,

The curves showing the changes in strength, with increasing amounts of silicon, can be seen in his book "The Metallurgy of Iron." These facts can be readily understood in the light of what has been said above on the effect of the proportion of graphite to combined carbon. Silicon is an aid to fluidity, and so from the foundry point of view is kept preferably on the high side. In ordinary engineering castings the amount present is nearer that given for maximum working qualities, and the tensile strength in the 1-in. square cast bar only drops about 1 ton per square inch to this amount. The other factors given below must be considered in this connection.

Sulphur.—This element, though only present in small quantities, has a marked effect in the opposite direction to silicon. It has other harmful influences, particularly its liability to produce "draws" and blow holes which affect the founder and the designer, and it should be kept at a minimum. The maximum for ordinary castings should be 0.15 per cent., and it should be below 0.1 per cent. for high-class work. Up to 0.3 per cent. is permissible and desirable for chilled castings.

Manganese.—This has the effect of increasing the combined carbon when present in large quantities. It has, however, the great advantage to the founder in counteracting sulphur by removing it or holding it in small particles as a substance that is practically harmless. It is one of the best correctives for badly melted and, therefore, unsound metal, and its presence up to 1 per cent. is desirable, causing a direct and indirect increase in strength without impairing machineability.

Phosphorus.—This is said to tend to coarsen the graphite flakes, which is an added reason for keeping it at a minimum.

Thus it will be seen that the analysis of the iron that is put into a casting has a very great effect on its strength and general qualities. But there is one further influence.

Rate of Cooling.

The effect of this is, briefly, that the slower the iron cools, particularly from the liquid condition to the solid, the more the iron carbide tends to split up, giving free graphite. This effect is very far-reaching and the whole character of the iron can be changed by altering the rate of cooling. The most well-known and marked effect of this is in the production of chilled castings. In this process an iron having an analysis, which would normally give a fair proportion of graphite, is poured into a mould, which is partly or entirely made of iron. This iron conducts the heat away from the liquid metal much more quickly than sand, and the result is that the iron carbide is retained as such for a certain depth on the surface of the casting. By judicious arrangement of the composition of the iron and the size of the chills, this surface effect can be varied to any depth at will. This property is invaluable where great surface hardness is required combined with strength, which latter is given by the unchilled portion in the centre of the casting. This process is comparable in effect to that of case-hardening steel. But this is an extreme case. In the ordinary method of moulding in sand, the rate of cooling depends mainly upon the section of the casting. It will be seen that for an iron of given analysis there must be one rate of cooling which gives just the right proportion of graphite to combined carbon to give the maximum strength.

For the purpose of elaborating this the writer has carried out a series of tests upon bars of varying section. Two types of iron were used: Series I., having silicon about 2.5 per cent. and phosphorus about 1.3 per cent., an ordinary iron for good soft medium-weight machinery castings: and Series II., silicon about 1.9 per cent. and phosphorus about 1.1 per cent., an iron used for castings requiring greater strength. The bars were all 13½ in. long and 1 in. deep, and were ¼, ⅜, ½, ⅝, ¾, ⅞, 1, and 1¼ in. wide. Attempts were made to cast bars ⅛-in. thick, but that for Series II., owing to low silicon and phosphorus affecting fluidity, did not run for more than 7 in., and that for Series I. not running well or sharp enough to be tested with the apparatus available. Both these bars were almost white when broken, especially the low-silicon one. The sets of bars for each series were cast from the same shank of metal, thus ensuring constant com-

* Extracted from "Machinery."

position of the metal. The variation in casting temperature would be very slight, but the runners were arranged so that the hottest metal was supplied to the thinnest bars, thus approximating to foundry conditions as far as possible. The satisfaction of these conditions was helped by the fact that they were cast from the ordinary run of metal in the foundries of Messrs. S. Russell & Sons, of Leicester. The results are set out in Fig. 1, the transverse strength of each bar being converted to its equivalent strength as a 1 by 1-in. bar broken on 12-in. centres.

As expected, each curve shows a maximum, the strength falling off for the lighter sections, as combined carbon was in excess of the amount for maximum transverse strength, and for the heavier sections, as the graphite was in excess. This change was clearly marked in Series I., the fracture of the ½-in. bar showing a uniform structure, and that of the ⅝-in. bar the structure typical of soft iron castings, that is a coarsening of the graphite flakes in the centre. The difference in the position of the maxima indicates clearly that for varying silicon contents the maximum strength is developed at varying sections, the lower the silicon the greater the section for maximum strength. The importance of this is now coming very much to the fore, and is illustrated in the proposals for standard test bars which have been submitted to the Institute of British Foundrymen and others for their approval. The suggestions include three bars of different section representing their equivalent section in the castings. These proposals, when completed, are to be submitted to the British Engineering Standards Association.

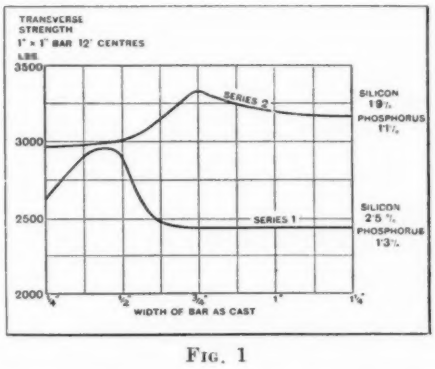

FIG. 1

The application of these facts to the design of castings should be fairly plain and may be summed up as follows:—

(1) The strength of a casting depends primarily upon the analysis of the iron that is put into it.

(2) This strength is very materially affected by the section of the casting, and various parts of the same casting will not be of the same relative strength if the thickness of these parts varies.

(3) Excessively thin parts of a casting are liable to be cooled so quickly as to become relatively very weak and particularly very hard.

It should be the duty of the foundryman to study the casting from these points of view and adjust his methods accordingly. But this is only practicable to a certain extent even in the largest and best organised foundries, and it is impossible to run each casting with just the right kind of iron to give the best results, either of strength or machineability, particularly as complications occur in attempting to melt widely divergent types of iron in the same furnace.

There are innumerable ramifications of this subject, but they cannot be dealt with here. One of the most important of these, viz., contraction, the writer hopes to deal with in some subsequent article.

AT THE ACKLAM WORKS of Dorman, Long & Company, Limited, Middlesbrough, on September 8, a ladle of molten metal was being hoisted when the rope broke and the ladle fell to the ground, severely injuring eight men. Six of those injured subsequently died, but the other two are progressing favourably. At the inquest evidence of identification was taken and the proceedings adjourned.

Use of Oxygen in Metallurgy.

Revolutionary changes in the metallurgy of iron by which production costs should be materially decreased and quantities of low-grade ore and smelting fuels now considered worthless be made available as the result of the use of oxygen and oxygenated air in blast-furnace practice are suggested in a report just made to the U.S. Department of the Interior by a committee appointed by the Bureau of Mines to study the problem.

The report points out that in the past it has been necessary in the production of one ton of pig-iron to pass three tons of inert nitrogen through the blast furnace, resulting in serious heat and metal losses. The elimination of such losses by the substitution of oxygen, or a mixture of oxygen and air, has long been considered, but has not been put into practice on account of the inability to produce oxygen in quantities at sufficiently low cost to make such application industrially possible.

In view of the many recent developments in oxygen manufacture, and considering the increasing cost and decreasing quality of American raw materials, the U.S. Bureau of Mines appointed an advisory committee, with Mr. M. H. Roberts, of New York, as chairman, to study the problem of the application of oxygen or oxygenated air to metallurgical and allied processes. This committee has made a thorough survey of the existing processes for the manufacture of 99 per cent. oxygen. The conclusions reached are that the comparatively small demand for the product has prevented the installation of large units suitable for metallurgical processes, with corresponding economies, and that by far the greater proportion of the present cost of oxygen represents the cost of transportation, storage and service. Large oxygen manufacturing plants can be built to serve metallurgical purposes directly, which will be capable of delivering oxygen at a cost not to exceed $3 per gross ton. In brief, the committee finds that the oxygen industry is now able to make plants for supplying large quantities of oxygen to metallurgical industries at low cost.

The data collected by the Bureau of Mines Committee indicate that the production and utilisation of cheap oxygen should also accomplish great economies in the metallurgy of zinc. It is believed that similar economies can be effected in the metallurgy of copper, and in fact in all branches of non-ferrous metallurgy. Great possibilities are pointed out in the application of oxygen in the manufacture of artificial gas and for various other industrial uses. The report states that the findings of the committee on these theoretical studies are so revolutionary in character that the members feel the strong advisability of conducting experimental work to verify the truth thereof, as well as to make changes in furnace design and processes in order to take full advantage of the probable benefits to be gained. The committee has developed plans for experimentally determining the effects of oxygen-enriched air upon the operation of the blast furnace, and it is recommended that these plans be put into effect as the first step of an extended research as to the general applicability of oxygen to metallurgy.

The knowledge that German industrial concerns are working actively on the application of oxygenated air to metallurgical processes is stated to have greatly concerned American iron and steel interests, and the industry is making insistent demands for research work of this nature.

The findings of the committee have been incorporated in Serial 2,502, "The Use of Oxygen or Oxygenated Air in Metallurgical and Allied Processes," which may be obtained from the Department of the Interior, Bureau of Mines, Washington, D.C.

Swedish Ironworks.—After the termination of the six months' lock-out, the Swedish ironworks restarted at the beginning of August. At the end of the month the following number were working:—Blast furnaces, 61 (111 average for 1913); Lancashire hearths, 77 (211); Bessemer converters, 12 (18); open-hearth furnaces, 50 (61); electric furnaces, 12. On account of the long stoppage, most of the works have orders on hand that will keep them occupied for the next few months.

Trade Talk.

ANOTHER BLAST FURNACE at the Redcar Ironworks of Dorman, Long & Company, Limited, is being damped down.

A LICENCE under the Non-Ferrous Metal Industry Act, 1918, has been granted to Kensington & Ribon, Limited, 148½, Fenchurch Street, London, E.C.3.

THE WHOLE OF THE SHARES in the foundry and engineering business of Herring & Son, Limited, of Chertsey, have been acquired by Mr. Trewhella, of Belsize Lane, London, N.W.

A DEMONSTRATION OF A new scaling hammer manufactured by the Electric Scaling Hammers, Limited, of London, was given at Swan Hunter & Wigham Richardson's Dry Docks, Wallsend, on September 13.

THE Mortimer James, No. 99 Powder Jointing Company, Limited, manufacturers of "Eerin" iron cement and enamels, have removed from 23, Upper Woburn Place, London, W.C.1, to 41, Berwick Street, London, W.1.

MESSRS. HARPER, PHILLIPS & COMPANY, LIMITED, of Grimsby, have recently cast an 18 ft. diameter cast-iron propeller, weighing nine tons, which is stated to be a record for the district. It is to be mounted on s.s. "Bothwell."

WILLIAM BEARDMORE & COMPANY, LIMITED, of Dalmuir, have booked another order for the North-Western Railway in India for five standard passenger superheated 4-6-0 type engines and six-wheel tenders, similar to the thirty already in hand for the Indian State Railways.

NOTICES were posted at the Barrow Steel Works, on September 16, that on the following night the works would close down owing to lack of orders. The works have been carried on from day to day. The two blast furnaces will, however, remain in blast, and also the hoop mills and foundries.

THE BOILERMAKERS' SOCIETY monthly report states that at the end of August there were 31,528 members unemployed. Mr. John Hill, the general secretary, points out the remarkable fact that although the shipyard members are locked out, the number of unemployed is less to-day than it was a year ago, when there was no dispute.

AT THE TWELFTH annual meeting and conference of the British Commercial Gas Association, to be held in Birmingham on October 1, 2 and 3, under the presidency of Mr. J. H. Lloyd, there will be official visits to the National Gas Exhibition, the Saltley Gas Works (including coke ovens), the Nechells Gas Works (including coal test plant and central laboratory), and the Industrial Research Laboratories. During the meeting Mr. A. W. Smith will read a paper on "The Practical Advantages of Gas Service to the Manufacturer," and Mr. C. M. Walter a paper entitled "Heat Treatment by Gas in Midland Industries."

MR. C. P. NEWMAN has purchased the Woodchester works of the United Brassfounders & Engineers, Limited, as a going concern from the receiver of that company. He has re-registered the name of Newman, Hender & Company, Limited, whose business was absorbed by the United Brassfounders & Engineers, Limited, in 1910, and which now resumes its independent identity. It is the intention of the new company to manufacture a complete line of valves, cocks and general steam and water fittings. The management of the company is in the hands of Messrs. C. P. Newman and W. Haworth, lately managing director and sales director respectively of United Brassfounders & Engineers, Limited.

THE TRIENNIAL GOLD MEDAL of the Institute of Transport has been awarded to Mr. Dixon H. Davies. Premiums in respect of the session 1922-23 have been awarded as under:—Railway (Operating) Gold Medal, Sir Philip Dawson, M.P.; Railway (Engineering) Gold Medal, Sir Robert Hadfield, D.Sc., F.R.S.; Road Transport (Passenger) Gold Medal, Mr. Sidney E. Garcke; Aviation Gold Medal, Major-General Sir W. Sefton-Brancker; Water Transport Gold Medal, Dr. Brysson Cunningham, D.Sc.; Dock and Harbour Gold Medal, Mr. Alfred H. Roberts; Institute Silver (Graduate) Medal, Mr. E. W. Bayliss; Institute Silver (Student) Medal, Mr. H. A. Groome; and "Modern Transport" Premium, Mr. A. Wardle.

COX & DANKS, LIMITED, iron, steel and scrap merchants, of Regent Street, London, W., have acquired the steel floating dock for testing submarines which was constructed for the German Navy, and came into the possession of this country on the cessation of hostilities. The structure will be broken up at the company's depôt at Queenborough. It weighs 5,000 tons, has a total length of 412 ft., and a breadth of 131 ft. Its outstanding feature is a large cylinder for the reception of the submarine for testing purposes. It is believed that the dock is the only one of its type in existence. The company are prepared to give facilities for those interested to view the dock at Queenborough. They are at present breaking up the Dreadnoughts "Erin" and "Orion."

Gazette.

THE HORBURY JUNCTION IRON COMPANY, LIMITED, are being wound up voluntarily, with Mr. E. D. Taylor, 7, Bond Place, Leeds, as liquidator.

THE SHAREHOLDERS of the Townhead Mining Company, Limited, have decided to wind up the company voluntarily. Mr. W. W. Casson, 34, Lowther Street, Whitehaven, has been appointed liquidator

MESSRS. G. PAUL, F. A. Nuttall, W. A. Smalley and A. Wolstenholme, engineers, ironfounders, brassfounders, etc., William Herbert Street, Blackburn, trading under the style of George Paul & Company, have dissolved partnership, so far as concerns Mr. W. A. Smalley.

Company News.

Zinc Corporation, Limited.—Dividend, 2s. per share on preference, less tax.

Empson Centrifugals, Limited, 39, Victoria Street, London, S.W.—Capital £20,000 in £1 shares.

Coltness Iron Company, Limited.—Usual half-yearly dividends on first and second preference shares.

Bristol Spring Company, Limited, The Spring Works, Abbotsford Road, Redland, Bristol.—Capital £1,000.

Milloyd Pulveriser & Engineering Company, Limited.—Capital £10,000. Solicitor: E. H. Johnson, 1, Water Street, Liverpool.

Cammell, Laird & Company, Limited.—Interim dividend, 2½ per cent., less tax, on 5 per cent. cumulative preference shares.

British Electric Transformer Company, Limited.—Consideration of payment of dividend on 7 per cent. cumulative preference shares deferred.

Ilfar Aluminium Company, Limited.—Capital £350. Foundrymen, refiners, smelters, etc. Solicitor: B. S. Gorton, City Chambers, High Street, Coventry.

Feuerheerds Rotors (Consolidated), Limited.—Capital £20,000 in 100,000 8 per cent. non-cumulative preference shares of 2s. and 200,000 ordinary shares of 1s. Manufacturers of and dealers in hydraulic pumps, etc. Solicitor: E. H. Riches, 4, London Wall Buildings, E.C.

Hardy Patent Pick Company, Limited.—Amount brought forward, £9,860; net profit, £23,931; available, £33,792; interest on debentures, £1,650; dividend on 7 per cent. preference for year, £2,100; 12½ per cent. on ordinary for year, £8,750; depreciation of plant, etc., £8,000; depreciation of tools and patterns, £2,000; carry forward, £11,292.

Welding & Engineering Company (Sheffield), Limited.—Private company. Registered September 10. Capital £5,000 in £1 shares, to carry on the business of welders and braziers, electrical engineers, rollers, tilters and forgers of all kinds of metals, etc. The subscribers (each with one share) are:—R. H. Aspinwall, 9, Ryle Road, Sheffield, electrical engineer; H. W. D. Fielding, Sheffield, solicitor. R. H. Aspinwall is the first director. Qualification, 100 shares. Solicitors: Smith, Smith & Fielding, Sheffield.

Obituary.

MR. J. L. DEXTER, managing director of Dexter & Company (High Wycombe), Limited, engineers and ironfounders, died recently in his 72nd year.

MR. A. MELLOR, of Holly Mount, Somerset Road, Almondbury, Huddersfield, the senior partner in Alfred Mellor & Sons, gas, steam, etc., engineers, Moldgreen, has died at the age of 70.

MR. W. H. TOMPKINS, of Highgate Avenue, Walsall, has died at the age of 40. In 1908 he took over from his father the business of Parkes & Company, malleable iron founders, Blue Lane, which he carried on to the time of his death.

MR. J. TORDOFF, who up to eight years ago was forge manager for the Monkbridge Iron & Steel Company, Limited, Leeds, died at his residence, Torwood, Bare Lane, Morecambe, on September 15, in his 83rd year. Before going to the Monkbridge Company Mr. Tordoff was manager at the Leeds Forge.

Contracts Open.

Bucarest, October 20.—Bronze bearings, for the Roumanian State Railways. The Department of Overseas Trade (Room 50).

Eccles, October 1.—Purchase of destructor scrap, baled tins, etc., from the Corporation of Eccles. Mr. G. W. Willis, Refuse Salvage Works, Peel Green Road, Patricroft.

Thetford, September 29.—1,800 yards of 7-in. and 4-in. cast-iron pipes, for the Corporation. Messrs. Sands & Walker, Milton Chambers, Nottingham. (Fee, £3 3s., returnable.)

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—Although very far removed from normal activity, business in the Cleveland iron market may be reported slightly improved as compared with recent experience, inquiries coming forward on an increased scale, which, it may be anticipated, may ultimately result in a substantial volume of actual transactions as the autumn advances. With Cleveland No. 3 G.M.B. now down to 96s. per ton, there is a somewhat better demand on forward account, and a few transactions have been recently noted covering the remainder of the year. The present quotation, it may also be remarked, brings Cleveland iron down to a competitive basis all round, and representing a likely rock-bottom level, when the high cost of fuel is considered, should certainly stimulate buying on a freer scale than has been experienced of late. There is, too, rather more inquiry for export, but it is not surprising that this side of the trade remains comparatively very quiet, in view of the disturbed financial and political conditions on the Continent. Messrs. Dorman, Long & Company, Limited, are damping down one of their furnaces on basic iron at their Redcar works, thus reducing the number of furnaces in blast on the North-East Coast to 39, as compared with 48 at the beginning of July. The figures are 11 on Cleveland iron, 12 on hematite, and 16 on basic and special kinds of iron. Following on the reduction in the No. 3 price, No. 1 is now about 102s., No. 4 foundry 91s. 6d., and No. 4 forge 89s. per ton.

Conditions in the hematite industry are somewhat unsettled, but with a slightly hardening tendency in values, 99s. per ton having been the ruling quotation this week, although for substantial business a slightly lower figure has been accepted. Some makers, however, were holding out for fully 100s. per ton this week, while the premium on No. 1 varies from 6d. to 1s. per ton, but sales of this quality have been actually effected at 100s. per ton. The home demand continues to show improvement, and there is a little more inquiry from the Continent. In West Cumberland and North Lancashire the position is unchanged, Bessemer mixed numbers being quoted at £5 10s. per ton, delivered at Glasgow and Sheffield, and £5 13s. per ton at Birmingham and £5 10s. South Wales. The demand for low-phosphorus iron is weak.

MANCHESTER.—As regards pig-iron, the foundry trade of this district is now practically supplied by the Derbyshire furnaces, with a little Northamptonshire iron coming in occasionally, and, perhaps, a small quantity of North Staffordshire iron. There seems to be quite an ample supply for the present state of trade, the actual consumption of the district being very much less than it used to be. Some idea seems to prevail that the Lancashire ironfounders have a good deal more work in hand than they are willing to admit, but the facts are against this assumption. Makers of Derbyshire No. 3 iron are still quoting 92s. 6d. per ton at the furnaces, and do not show much inclination to shade this price, although from time to time one hears rumours of their doing so. There is practically no competition now with Derbyshire iron except between the various furnaces of the county, and some of these, it is said, have some pig-iron accumulating.

THE MIDLANDS.—At the close of the current quarter business in the local pig-iron market discloses a slightly better tendency, but with little prospect of any permanent improvement while the costs of furnace fuel remain at their present inflated values. Inquiries are handled very cautiously, for though business is so badly wanted no smelter is keen to book any large contracts at the prices now prevailing. There is a not unreasonable desire to keep some margin for possible improvements. For the present the best that can be said is that there has been a slight expansion of demand, though it has not yet run to contracts of any size, but there is a more hopeful inquiry. Quotations: Northamptonshire No. 3 foundry, 90s.; Derbyshire No. 3 foundry, 92s. 6d., all net f.o.t. furnaces.

SCOTLAND.—Business in the Scotch pig-iron market remains quiet, with buying on home account still on restricted lines, although there is a slightly better demand in the export section. The local foundry trade is, however, seriously affected by the prolonged continuance of the boilermakers' dispute, which is completely holding up work in Clydeside shipyards, and of which, so far, there is no sign of a settlement. The few transactions recorded last week included some moderate buying for lots up to the end of the year, said to have been taken at slightly below current prices, quotations ruling as follows:—No. 3 Scotch, 100s. f.o.t. furnaces, and No. 3 Middlesbrough is 101s. f.o.t. Grahamston, No. 4 foundry being 4s. 6d. per ton less. No. 3 Midland iron, however, is on offer at under 100s. delivered here.

Finished Iron.

It is satisfactory to note that at last week's Birmingham market, manufacturers of finished material were able to report a slightly improved tendency on the part of buyers in this section. There was a distinctly better volume of inquiry for some classes of materials, and though no very large accession of new orders was reported the general outlook was certainly more hopeful than for some time past. Of course, there can be no general improvement until such obstacles as the boilermakers' strike are removed, and there is still room for the Wages Board to apply itself to level up some of the inequalities which resulted from the introduction of the eight hours working day.

Steel.

The outlook in the steel trade gives promise of improvement, and during the past week the market experienced a sharp revival of demand, consequent upon a substantial volume of inquiries on Japanese account. The willingness with which buyers are contracting forward is, in fact, the most satisfactory feature of the trade, as the absence of this class of business during the past year or eighteen months has had much to do with the prolonged depression in the iron and steel trades. At Sheffield, while a fair amount of business is reported in basic billets, makers of acid qualities have not experienced any improvement. It is stated that three-fourths of the acid steel furnaces in Yorkshire are idle, but the crucible-steel makers are having a rather better time just now, though the orders are not on a very substantial scale. There is a good deal of business doing in railway and motor-car steel again. In the market for alloys ferro-manganese for domestic consumption is in request for small quantities only, with a few 10/20-ton lots for the Continent, prices being unchanged. A large Belgian inquiry for 1,000 tons of spiegeleisen has also been dealt with. There has certainly been more doing in tinplates the last week or so, due no doubt to the fact that the makers have decided to keep the minimum selling price at 23s. 1½d. for the next three months.

Scrap.

The general depression now prevailing in the iron and steel industries is again reflected in scrap metal trade conditions, which remain, with rare exceptions, stagnant in the extreme. The demand for steel melting scrap in South Wales was reported rather better a little while ago, and possibly in that district there is not so much scrap in the hands of dealers, but in other parts of the country, and notably in Lancashire, the prices are very low. In the cast scrap-iron market selling prices continue unsatisfactory. They have not been altered for more than a month, and in the meantime foundry pig-iron has fallen by about 5s. per ton, and this is a fairly sufficient proof that the prices for foundry scrap are well below the intrinsic value of the material. The usual price in most parts of the country is 80s. per ton delivered for ordinary qualities of broken machinery metal, but in Lancashire, where textile machinery scrap is more in evidence, dealers sometimes get 85s. for the best lots. In the Scottish markets cast-iron scrap still remains firm. Inquiries are fairly numerous, and it is very difficult to pick up parcels of any quantity. A number of the yards have fair stocks of large metal requiring breaking, but the process of handling this material and of delivering is of necessity somewhat slow, and for this reason sellers are not inclined to commit themselves to any great extent. Heavy machinery cast-iron scrap and scrap railway chairs run about 92s. 6d. to 95s., and ordinary cast-iron scrap 82s. 6d., light metal and furnace fire-bars being offered at 65s.

Metals.

Copper.—Values in the standard copper market during the past week have steadily declined, largely due to the absence of a definite tendency in America, also to substantial realisation on speculative account. Technically, however, the position of warrant copper is rather stronger, while engagements on the short side have been added to under the recrudescence of pessimism based on the continued lack of buying by American consumers and indications of some deterioration in the statistical outlook. For the present, at any rate, the American refinery production is in excess of current demands, and in view of the fact that the larger American producers are disposed to continue selling freely direct to consumers, and thus to avoid dealers, the trend of prices remains in consumers' favour. Current quotations:—*Cash*: Thursday.

METAL MARKETS—*continued.*

£62 7s. 6d.; Friday, £63; Monday, £63 2s. 6d.; Tuesday, £63 15s.; Wednesday, £63 5s. *Three Months*: Thursday, £63; Friday, £63 10s.; Monday, £63 12s. 6d.; Tuesday, £64 2s. 6d.; Wednesday, £63 12s. 6d.

Tin.—During the last day or so the market for standard tin has developed a reactionary tendency, heavy sales in the East having caused some apprehension that the often-threatened liquidation of stocks by the Federated Malay States has at length materialised. Notwithstanding these conditions, the American demand is still a factor, while home users may be in the market again shortly in view of the movements in the tinplate trade. Tin having had a good run up from the low figure touched in July, something in the nature of a downward reaction was only to have been expected. This month's Straits shipments may be estimated at about 5,000 tons, and the contributions from Java as cabled for August at 1,250 tons are comparatively light. It is rumoured that the auctions of Banca tin in Holland, which were held periodically before the war, will be resumed in the early future. Current quotations:—*Cash*: Thursday, £198; Friday, £197 10s.; Monday, £202 10s.; Tuesday, £203 5s.; Wednesday, £200 5s. *Three Months*: Thursday, £198 5s.; Friday, £197 5s.; Monday, £200 17s. 6d.; Tuesday, £202 17s. 6d.; Wednesday, £202 5s.

Spelter.—The market for this metal of late has developed a somewhat irregular tendency, with fluctuations inclining to lower levels. The market has been more or less under the influence of American cables, and Belgium was always a seller. The talk of a world shortage in the near future has not moved users much. Political developments, speculative selling profit-taking after the recent rise, coupled with the absence of some of the leading operators on holiday, were chiefly responsible for the moderate declines. Current quotations:—*Ordinary*: Thursday, £33 6s. 3d.; Friday £33 10s.; Monday, £33 16s. 3d.; Tuesday, £33 17s. 6d.; Wednesday, £33 17s. 6d.

Lead.—Business in soft foreign pig has been slightly more active, and the market remains fairly firm. The American building trade is reported to be busy, and with no excessive production of lead in the States, it does not seem as if world supplies are anywhere greater than present consumption can comfortably absorb. Current quotations:—*Soft foreign (prompt)*: Thursday, £25 10s.; Friday, £25 10s.; Monday, £25 12s. 6d.; Tuesday, £25 16s. 3d.; Wednesday, £26.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

What is Semi-Steel?

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—Since my return home from Paris I have read with interest your leader in issue of September 13, entitled, "What is Semi-Steel?" The object of my Paper was the guidance of foundrymen in making this mixture. Some theoretical considerations were introduced, and although no actual definition was offered, I arrived at the conclusion that fine graphite was responsible for the improvements over ordinary cast iron, my arrival at this conclusion being aided by direct evidence of fine graphite, by the examination and rejection of other possibilities, and further by a comparison between semi-steel and malleable iron. These were detailed in the Institute of British Foundrymen's Proceedings, 1920-21, pages 323-4. Since that time experiments on the magnetic and electrical properties of this mixture have shown that in these directions, also, the metal excels by virtue of its continuity of structure, or absence of long graphite flakes.

To my mind your excellent definition touches the heart of the question, for I have proved that if this metal be cast cold and the graphite allowed to grow, the improvements are no longer found. Nevertheless, I do not think that semi-steel founding has yet arrived at that degree of precision which will allow of the acceptance or rejection of castings on the basis of an examination under the microscope.

Yours, etc.,

HERBERT FIELD.

Albion Works, Willenhall, Staffs.
September 29.

"Moulders" of the Industry.—No. 16.

Mr. S. H. Russell.

Mr. S. H. Russell is a partner in the firm of Messrs. S. Russell & Sons, engineers and ironfounders, of Leicester. This concern was established in 1864 by Mr. Russell's grandfather. Mr. Russell was born in 1886, and was educated at Wyggeston Grammar School, Leicester Technical School and Birmingham University. He joined the Institute of British Foundrymen in 1908, and

MR. S. H. RUSSELL.

was local secretary for the Leicester Convention in 1914. It was largely through his efforts that the East Midlands Branch of the Institute was formed. This year he occupies the chair of this branch.

On the formation of the British Cast Iron Research Association he became actively interested in it, and now serves on its Executive and Technical Bureau Committees. The firm with which he is associated specialise in high quality iron castings for engineers and boot and shoe and hosiery machines. Other departments include a non-ferrous foundry, general engineering shops and constructional steel work.

Cast Iron and Mass Effect.

Mr. Smalley points out that an inaccuracy which existed in the advance copies of this Paper also appeared in last week's JOURNAL. The etchings, Nos. 1, 2 and 3, Fig. 5, are in their wrong order. Also the S content on page 250, column 1, line 19, should read 0.97 per cent. in place of 0.37 per cent.

THE COMPETITION which Messrs. Beecroft & Partner, Limited, are organising to find a slogan for their Sandoil closes next Monday.

MR. ANDERTON WARDLE, late of the Daimler Company, and patentee of the Britannia jar ram moulding machine, is resigning his position as consulting engineer to the Holcroft Steel Foundry Company, Limited, and Hickman's iron foundry, Bilston, to take over the management of the foundries and pattern shops of Sir W. G. Armstrong, Whitworth & Company, Limited, Manchester.

NEW BLAST FURNACES IN HOLLAND.—A German steamer arrived recently at Velzen (a village on the North Sea Canal near Ymuiden) one morning at 1 a.m. with the first cargo of Swedish iron ore, aggregating about 4,300 tons, which she commenced discharging at 6 o'clock the same morning and completed 30 hours afterwards. The ore was for the new blast furnaces near Velzen. The plant is of modern construction, and is equipped with the latest type of loading gantries and cranes. The ore is discharged by grabs direct from the steamer into bunkers, specially built for its reception.